# Being informed in the digital age?

## A communication perspective on information relevance in algorithmic media

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# Abstract

This research seeks to answer the question of how *information relevance* arises in *algorithmic media*. The term *algorithmic media* is a generic term for digital applications that personalize information on the basis of algorithmic procedures. *Information relevance* in this context describes the process by which certain information achieve extended visibility. Current research in the area has given valuable insights into how algorithms shape everyday information practices and what their implications are on a broader social and cultural level. The principal understanding of algorithms critical social research is generally based on is a mathematical-theoretical one: algorithms are defined as mechanical step-by-step instructions. In relation to the research object of this study, however, it can be stated that algorithms operate by analyzing user behavior. The goal of this research is therefore to establish a perspective that takes the crucial component of *user behavior* into account. It thereby aims to create an a*pplication-based understanding* of information relevance in algorithmic media centered around the algorithm-user-relationship.

Theoretical starting point is the development of a communication perspective on information relevance in algorithmic media. Algorithms and users are hence conceptualized as *communicative others* that are connected by a communicative relationship. This communicative relationship is then investigated further empirically. Drawing on 25 expert interviews, analyzed following a qualitative coding process, four communicative dynamics that shape algorithm-user-communication were identified: (1) the functional-strategic dynamic; (2) the narrative dynamic; (3) the knowledge-awareness dynamic; and (4) the action dynamic. Combining the theoretical and empirical insights results in a *morphological model* that visualizes information relevance in algorithmic media. With this model, this research contributes with a novel basis for examining and discussing algorithmic procedures in the digital realm.

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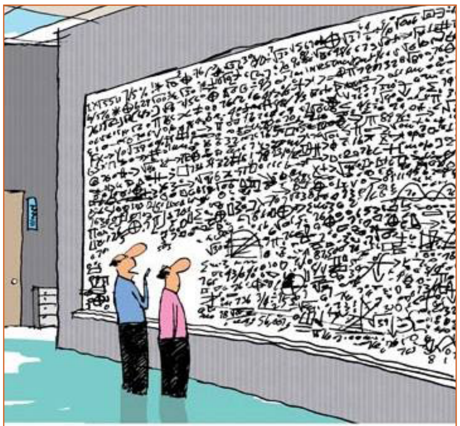


...And that, in simple terms, is how you increase your ranking on search engines."

# 1. Introduction

What does it mean to be informed in the digital age, where algorithms have become an inevitable part of digital news media? How can users make sure they do not get caught in so-called filter bubbles, which supposedly withhold divergent opinions? Current research in relation to these questions has led to valuable insights concerning, for example, how algorithms shape everyday information practices and their broader social and cultural implications (e.g., Beer, 2009; Bucher, 2012; Gillespie, 2014; Mager, 2012). Critical research on algorithms addresses its research object mainly from a mathematical-theoretical perspective, which defines algorithms as "sets of defined steps structured to process instructions/data to produce an output" (Kitchin, 2017, p. 14, Charbert and Barbin, 1999, p. 1). In the scope of this study, however, algorithms operate by analyzing user behavior, which makes it crucial to include this component when studying algorithms in relation to digital news media. The insight that algorithms and user behavior are inevitably linked is the starting and main focal point of this research. It aims to develop a model that accounts for the way algorithms work in relation to user behavior. The development of such a model is valuable insofar as it will contribute to an application-based understanding of information relevance in algorithmic media. Ultimately, this research aims to create a novel basis for examining and discussing the initially posed questions and thereby hopes to spark a discussion on the very understanding of algorithms and information relevance in the digital age.

## 1.1 Algorithmic media and information relevance

Over the past few years, the term algorithm has become a medial buzzword referring to a programmed mechanism – complex and inscrutable (see cartoon above[1]) – regulating digital information flows, predicting users' tastes and, thus, ultimately shaping human minds. One of the driving catalysts behind this debate has been internet activist Pariser's (2011) claim that the use of algorithms leads to what he calls a 'filter bubble'. He argues that "the rise of pervasive, embedded filtering is changing the way we experience the Internet and ultimately the world" (p. 218).

Drawing on Pariser's analysis, rather fierce journalistic debate and public speculation emerged suggesting that algorithms pose a threat to modern democracies. Journalist Grubb (2013), for example, warns in *The Sydney Morning Herald* against a "distorted world view" constructed by "computers [that] are doing our thinking for us". Journalist Hickman (2013) states in *The Guardian* that we "are now largely determined by algorithmic vagaries". Public speaker Salvin (2011) declares in a TED talk that algorithms "shape our world", and media expert Meckel (2011, 2011a) expresses her concerns about losing human serendipity. The general tone within this journalistic and public debate has been critical, skeptical, and partially apocalyptic. One major concern is that algorithms increasingly "have the power to shape our tastes, to reconfigure our interests and to potentially define how we understand and engage with the world around us" (Beer, 2014).

1 Source: http://www.pagetrafficbuzz.com/wp-content/uploads/2011/08/googlejoke.jpg (last access 2.8.2017)

The public debate on algorithms as new powerful tools is in contrast to the widespread use of what I refer to in this research as 'algorithmic media'. The best known example of algorithmic media is Facebook's News Feed. Young adults in particular use Facebook's News Feed several times a day as their primary source of news and information (Mitchell et al., 2013). A distinctive element of algorithmic media is the inherent process of personalizing information on the basis of algorithmic procedures. This process is sometimes also called algorithmic personalization. According to the statistics website Alexa (2017), Google, Facebook and YouTube are the most used websites worldwide and all of them use algorithmic procedures as part of their service. This shows the strong immersion of algorithms in the digital realm.

One of the main reasons why algorithms are employed is the vast amount of digital information. Within Facebook's News Feed, for example, an average user receives around 1500 stories (Backstrom, 2013, Constine, 2016). Instead of presenting them all chronologically, Facebook decided to develop an algorithm that extracts and displays so-called top stories: stories that are most relevant to their users.

Very little is known about this process of achieving visibility, which in this research I call 'information relevance'. Numerous engineers and practitioners in the field of digital marketing are constantly trying to decode the algorithms. At one point, Socialbakers (2014) created the so-called Edgerank checker. With the help of the reverse-engineered algorithm, they identified affinity, weight and time decay as the three major components influencing information relevance in algorithmic media, in other words what information gets shown. Another article in the online publication *Marketing World* states, however, that more than 100,000 individual factors influence the position of a single item (McGee, 2013). This shows how complex the matter is and how little is known about information relevance in algorithmic media.

## 1.2 Algorithmic media – a threat to the informed citizen?

According to blogger and SEO expert Sullivan (2008), algorithmic personalization has been one of the biggest changes on the internet. It all began with Google personalizing search queries. Traditionally, users using the same search query would receive the same results. Since December 2009, search queries are personalized and the above-mentioned internet activist Pariser was one of the first to point towards the socio-political implications. Pariser, who hoped that "the Internet was going to democratize the world, connecting us with better information and the power to act" (p. 3), claims to be profoundly disillusioned. He concludes: "These engines create a unique universe of information for each of us – what I've come to call a filter bubble – which fundamentally alters the way we encounter ideas and information" (p. 9). Pariser argues that algorithms, as the underlying structure of the internet, have become a pervasive filter mechanism favoring organizational agendas and concentrated control rather than decentralized and well-balanced information flows. In his eyes, the user and thereby society are thus prone to end up in individual filter bubbles, generated by algorithms.

What makes algorithms highly controversial is their relation to the in-/visibility of information. Media researcher Bucher (2012) examines Facebook's News Feed algorithm and identifies a "threat of invisibility" (p. 8). She writes: "Becoming visible, or being granted visibility is a highly contested game of power in which the media play a crucial role" (p. 2). She concludes that on the internet the mechanisms for granting visibility have become more important than the question of what is actually visible. Law Professor Lawrence Lessig (2000) even proposes that "code is law". He states that the internet is as equally regulated by code as it is by the market, laws and norms. Further, internet researcher Galloway (2006) considers technological protocols to be "a pseudo-ideological force that has influence over real human lives" (p. 81). The uniting argument of all these discussions is that software structure and, more specifically, algorithms are a strong regulating force of human behavior on the internet.

Unsurprisingly, then, algorithms as media technology are strongly criticized, especially with regard to the democratic concept of being an 'informed citizen'. The idea of an informed citizenry as the basis of democratic societies dates back to greek philosophy. Well-known sociologist Alfred Schütz (1946) writes that being a "well-informed citizen" means "to arrive at *reasonably founded* opinions in fields which as he knows are at least mediately of concern to him although not bearing upon his purpose at hand" (p. 466, emphasis in the original). This idea of a well-informed citizen who can make informed decisions often serves as an implicit reference point in relation to algorithmic media. It has been argued that media contributes to the wide availability and accessibility of information but, with the use of algorithms, it looks as if we are moving even further away from this idea(l).

### 1.3 The relevance of information relevance in algorithmic media

The developers of algorithmic media have been redefining what 'relevant news' is – a concept typically claimed by journalists. Facebook founder Mark Zuckerberg (2006) addresses first user comments on the just introduced News Feed back then as follows:

> This is information people used to dig for on a daily basis, nicely reorganized and summarized so people can learn about the people they care about. You don't miss the photo album about your friend's trip to Nepal. Maybe if your friends are all going to a party, you want to know so you can go too. Facebook is about real connections to actual friends, so the stories coming in are of interest to the people receiving them, since they are significant to the person creating them.

This statement shows two key ideas of News Feed and, hence, algorithmic media. First, that algorithmic feeds combine scattered information in one central location and, second, that news is selected according to the identified user's interests. Zuckerberg believes that "a squirrel dying in front of your house may be more relevant to your interests right now than people dying in Africa" (Gross, 2011). This often cited quote strongly emphasizes the idea that algorithmic media is based on: What matters and is regarded as relevant is the individual user's interest. User interest is retrieved from the user's click behavior; the information a user clicks on is regarded as relevant. If a user for example solely clicks on party invitations, it is assumed that this is of importance to the user. This underlying assumption is the essential difference between journalistic news media and algorithmic media. Very broadly speaking, journalistic organizations orient themselves by means of socio-political agendas while the developers of algorithmic media put the user first. This raises important questions. Research has shown that algorithms are not neutral but carry developers' values (Introna/Nissenbaum 2000). The question therefore arises as to which values are supported? This discussion is taking place against the backdrop of what Lessig (2009) calls the 'internet prejudice'. Internet prejudice means that the internet represents freedom and thereby alters democratic values. Researcher have shown that this is seldom the case; software seems to be biased towards market values (e.g., Introna and Nissenbaum, 2000, van Couvering, 2010). While there was the hope that the internet would become a space in which the conventionally disempowered had the ability to raise their voices outside of traditional information and power structures, today many are disillusioned. Algorithmic media has been facing the same critique: apparently there is too much emphasis on popularity and well-linked pages, which may favor certain organizational agendas (e.g. Fuchs, 2014) over a democratic choice.

### 1.4 Initial thoughts and research question

Initially, I also began my research by approaching algorithmic media with the mathematical-theoretical definition of algorithms in mind. I interviewed software practitioners with the aim of deconstructing the rules and routines of algorithms. Throughout the research process, however, I faced the same responses that Pariser mentions in his book. He quotes, for example, search expert David Sullivan with: "If they opened up the mechanics (...) you still wouldn't understand it" (Pariser, 2011, p. 202). The problem for me was thus not, as previously anticipated, a lack of willingness to talk to me as a researcher but to talk about and understand the algorithms. No matter how long and how deeply I inquired into algorithmic technology, none of the practitioners were able to extract individual factors. This was not due to a lack of willingness; on the contrary, the companies were more than willing to grant access but – as I later understood – due to their different understanding of algorithms. After the first interviews, I came to realize that the mathematical-theoretical understanding of algorithms does not account for algorithms in practice as used in algorithmic media.

How then do companies determine the success of their services if they are not able to backtrack and modify individual factors? Throughout my interviews, I learned that, for them, the most important measurement is the actual click from a user. If a user clicks on a result, this particular result is considered relevant. Ideally, most relevant information – in other words, a news item a user clicks on – is ranked on top, followed by the second most relevant information and so on. From a technical point of view, it is counterproductive if a user does not click on any item because then they receive no feedback (see in more detail chapter 2.2).

These initial insights strongly influenced my research and shaped consequently the main overall research question, which reads: *How does information relevance arise in algorithmic media?*

## 1.5 Chapter outline

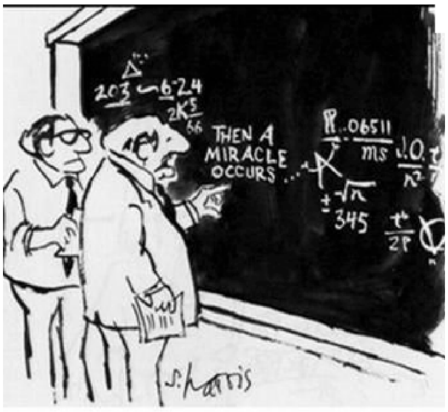
This thesis consists of five main chapters, which I will briefly outline in the following. The *second chapter* serves as a starting point for this research and establishes the background to the study. It starts with an inquiry into algorithms and their context, the digital realm. The crucial element in this chapter is the presentation of a patent description of algorithmic media. The patent description shows how algorithms are linked to user behavior and therefore serves as evidence for the idea of studying algorithms in relation to user behavior. The chapter further inquires into how organizations communicate their algorithmic processes and how algorithms are understood from a computer scientist perspective.

The *third chapter* establishes the conceptual framework, which proposes an understanding of information relevance as algorithmic-user-communication. The groundwork for this inquiry is a description of the field this research is located in, namely internet studies. I then present an example of a systems approach to algorithms, based on the understanding of algorithms as step-by-step instructions. This is followed by an argument on how a communication perspective can help provide a different understanding of information relevance in algorithmic media. In conclusion, I propose an understanding of algorithms and users as communicative others linked via communication.

In *chapter four* the method and process of data analysis is described in more detail. The aim of the empirical data collection is to examine and describe the algorithm-user-communication in depth. In total, 25 expert interviews were conducted, transcribed and analyzed following the process of qualitative coding. Challenges in relation to the chosen method and the selection of the interviewees are also addressed.

*Chapter five* presents the result of the empirical analysis. Four communicative dynamics that shape information relevance in algorithms media have been identified. The four dynamics identified are termed (1) 'functional-strategic dynamic', (2) 'narrative dynamic', (3) 'knowledge-awareness dynamic' and (4) 'action dynamic'. The descriptions are substantiated through the interview material.

The final *chapter six* summarizes and integrates the research conducted by proposing a morphological model that is able to visualize information relevance in algorithmic media. The model is described in depth and then discussed in relation to the broader concepts of power and communication, filter bubbles and echo chambers, the public sphere and the informed citizen. The final chapter discusses the research by critically examining algorithmic media, and is followed by concluding remarks that answer the questions raised in the introduction, looks at user agency and propose ways of working further on this topic.




*"I think you should be more explicit here in step two."*

# 2. Algorithms in the digital realm

Lately, the term algorithm has become a media buzzword that "developed into somewhat of a modern myth" (Barocas, Hood and Ziewitz, 2013). Striphas (2012) writes:

> One of the things that strikes me (...) is the extent to which the word algorithm tends to go undefined. It is as if the meaning of the word were plainly apparent: it's just procedural math, right, mostly statistical in nature and focused on large data sets? Well, sure it is, but to leave the word algorithm at that is to resign ourselves to living with a mystified abstraction. (Striphas, 2012, para. 2)

As Striphas points out the term algorithm stands typically undefined in current discourse and academic literature. It is often used to describe complex computational processes, somewhat difficult to explain and understand. Therefore, one could assume that algorithms are a phenomenon of the digital realm, however, their origin lies in fact in the Persian Empire. The actual word algorithm evolved through a translation of mathematician Al-Khwarizmi's work during in the 18th century (Charbert and Barbin, 1999, p. 2). As written in the introduction, algorithmic procedures build the basis of digital computing processes and are subject to various journalistic and public debates. For example, in the online version of *The New York Times* a simple search for the term algorithm resulted in over 2.000 articles[2]. Within them, the term is often used dualistically, describing something that is both very complex and somehow very simple. In an article on modifications of Google's PageRank algorithm journalist Steve Lohr (2011) writes:

> Computers are only as smart as their algorithms – man-made software recipes for calculation, the basic building blocks of computerized thought. When running on powerful computers, a clever algorithm can perform amazing feats. Google's algorithm handles one billion search queries a day. But algorithms are often brittle and simple-minded, doggedly following their step-by-step formulas as if with blinders. (para. 5)

Often, journalistic articles describe algorithms in such contradicting ways and mostly do not go beyond this explanation. For the critical reader the question of how algorithms evolved from step-by-step formulas into more or less 'clever performers' remains unclear and therefore questionable. The very notion of algorithms as step-by-step instructions goes back to introductory descriptions of algorithms in mathematical textbooks. Charbert and Barbin (1999), an often cited textbook on this subject, write:

> Algorithms are simply a set of step by step instructions, to be carried out quite mechanically, so as to achieve some desired result. (...) Given the discovery of a routine method for deriving a solution to a problem, it is not surprising that the 'recipe' was passed on for others to use. (p. 1)

Drawing on this definition, it is widely assumed that algorithms employed in practice such as Google's search algorithm or Facebook's News Feed algorithm are step-by-step instructions. Hence, the aim of many social science researchers has been to shed light on these specific instructions. The starting point of this research is that this approach to algorithms lacks exploratory power when it comes to algorithmic media and the inherent process of creating information relevance. Brin's and Page's (1998) first conference paper regarding PageRank shows that computer algorithms are complex

2 https://www.nytimes.com/ (last access 17.08.2017)

mathematical formulas rather than step-by-step instructions:

> The PageRank of a page A is given as follows:
>
> $$PR(A) = (1-d) + d\left(\frac{PR(T1)}{C(T1)} + \ldots + \frac{PR(Tn)}{C(Tn)}\right)$$

Furthermore, as argued in the introduction, information relevance is based on the analysis of the user behavior, which therefore must be taken into account when exploring algorithmic processes. Thus, the following chapter inquires more deeply into the question of how to understand and conceptualize algorithms in algorithmic media. In search of answers, I first investigate three defining concepts of the digital realm: (1) digital information overload, (2) big data and (3) convergence culture. Then, I examine a patent description of an algorithmic media service. This patent description highlights yet again the importance of algorithm-user relationship as a constituting factor of information relevance in algorithmic media. Following, I then present and analyze marketing descriptions from some of the most popular algorithmic media platforms. Finally, I draw on theoretical insights in the field of information retrieval and artificial intelligence to show how algorithms are theoretically presented in the field of computer science. The overall goal of this chapter is to establish the research background, provide the context of the study and to show that the algorithm-user relationship is the crucial element in algorithmic media.

## 2.1 The digital realm

Lev Manovich (2001), theorist in the field of digital humanities, states in his often-cited book *The Language of New Media* that "today we are in the middle of a new media revolution – the shift of all culture to computer-mediated forms of production, distribution, and communication" (p. 19). He writes that "the computer media revolution affects all stages of communication, including acquisition, manipulation, storage, and distribution; it also affects all types of media – texts, still images, moving images, sound, and spatial constructions" (p. 19). Even though the term revolution seems slightly inflated, Manovich's observation of a profound shift towards the digital can be fully agreed with. Contemporary society is based on the digital realm, in other words the internet. We receive all kinds of information via the internet: presentations are uploaded, phone conversations are carried out through digital infrastructure and even TV programs have become fully digital. Further, entire digital markets and industries have emerged. Where these developments will lead is hard to predict. However, there are three key characteristics of today's society in relation to the digital realm on which I will elaborate in the following: (1) digital information overload, (2) big data and (3) convergence culture. These concepts are not a comprehensive list of what characterizes current society but they most crucial and hence build the backdrop of this research.

The famous philosophical quote *panta rhei* is the starting point and underlying notion for this description of concepts constituting the digital realm. Roughly translated, it means 'everything flows'. That is to say, media and society undergo constant change and are thus both in constant flow. Digital technology is continuously being advanced and adapted. Therefore, this inquiry into the digital realm needs to be understood through the lens of constant change. Change is not something that arises repeatedly but change is the foundation of the digital realm. In this light, the three concepts outlined below are described as they existed at the time of research. In particular, I carve out some defining characteristics within the presented concepts, which shed light on the digital context algorithmic media is situated in.

### (1) Digital information overload

Sharing, tagging and liking have become prolific practices and every one of those clicks produces more information. Hence, journalists do not only compete with other professionals in the field but also with everyday users and their smartphones. Nowadays, almost anybody can create news by uploading content to relevant sites. This constant production of news has implications not only for the producers of it but also for the consumers. The ability to create and share news on the spot has contributed to a massive amount of instantly available information. Therefore, modern societies are usually referred to as information societies. These descriptions start with the notion that information has become a commodity. Webster (2014), one of the leading theorists in the field, notes:

> What strikes one in reading the literature on the Information Society is that so many writers operate with undeveloped definitions of their subject. It seems so obvious to them that we live in an Information Society that they blithely presume it is not necessary to clarify precisely what they mean by the concept. (p. 8)

Even though Webster points towards underdeveloped definitions, there seems to be an agreement that information as a commodity lies at the center of information societies amongst researchers according to Webster. Through the analysis of established writings, Webster identifies five dimensions that current definitions of information society touch: (1) technological, (2) economic, (3) occupational, (4) spatial and (5) cultural. Balnaves and Willson (2011) take the information-as-commodity concept a step further by pointing towards its digital materiality: "It was Claude Shannon's algorithms in electronic engineering that started the idea that information is quantity" (p. 2). The writers state that electronic engineering has pushed the idea of information as a commodity forward. Within digital information systems information is translated into binary code and thus made computable. This development leads Balnaves and Willson to conclude: "That information as a quantity is now taken for granted as is the understanding that the more information you have access to, the better" (p. 2). This idea "the more information, the better" has become an ideal and imperative of contemporary society. Numerous internet activists (e.g., Aaron Schwartz) have openly advocated for free access to knowledge online. While access to such a vast amount of information is definitely a great advantage, the flip side is an amount of information that has become unmanageable. This phenomenon is often called information overload. Information overload is a concept established by Alvin Toffler (1970) before the emergence of the internet. He describes it in his book *Future Shock* as a "cognitive overstimulation interfer[ing] with our ability to 'think'" (p. 311). He bases his claim on the observation of factory employees working on assembly lines, where an employee's task was to sort children's blocks. Toffler argues that at a reasonable speed, the worker will be able to work with almost hundred percent accuracy. However, when the complexity of the assignment increases, the worker needs more time to process the data, which leads Toffler (1970) to conclude:

> We are forcing people to adapt to a new life pace, to confront novel situations and master them in ever shorter intervals. We are forcing them to choose among fast multiplying options. We are, in other words, forcing them to process information at a far more rapid pace than was necessary in slowly-evolving societies. There can be little doubt that we are subject to at least some of them to cognitive overstimulation. What consequences this may have for mental health in the techno-societies has yet to be determined. (p. 315)

Thus, Toffler had already identified a trend towards overstimulation before the wide spread of the internet. Today, the phenomenon of overstimulation appears to be even more severe in the digital realm. Therefore, labeling this development as digital information overload seems helpful. This does not mean that digital information overload leads to even more overstimulation; however, it points towards the vast amount of digital information and its instant availability. While it might have been possible to decrease the speed of an assembly line, information on the internet cannot be overlooked in its entirety. This interconnectedness of information is what makes the internet what it is. A piece of information is typically linked to another piece of information.

It is this seemingly endless stream of information that may lead to overstimulation and the perception to what is called digital information overload.

### (2) Big data

Following the notion of digital information overload another term became influential in this context: big data. Today, almost every step a person takes touches the digital realm; from finding directions to document sharing. People's interactions leave constant digital traces that accumulate in big data sets. Generally, big data is used to describe a large amount of data. However, as Boyd and Crawford (2012) point out, big data is less about being 'big' "than it is about a capacity to search, aggregate, and cross-reference large data sets" (p. 663). However, big data carries also the connotation "that large data sets offer a higher form of intelligence and knowledge that can generate insights that were previously impossible, with the aura of truth, objectivity, and accuracy" (Boyd and Crawford, 2012, p. 663). Based on the idea that large data sets promise truth and objectivity Chris Anderson (2008) famously claimed the end of theory:

> The new availability of huge amounts of data, along with the statistical tools to crunch these numbers, offers a whole new way of understanding the world. Correlation supersedes causation, and science can advance even without coherent models, unified theories, or really any mechanistic explanation at all. (para. 19)

Regardless of the discussion on whether big data makes theory obsolete or not, a number of internet companies have begun to base their business models on the effective analysis of big data sets. Here, one of the more controversial points is the exploitation of user data for targeted advertising. Many services offered "free of charge" come at the cost of private data.

Big data is a fact of the digital age and so, apparently, is the practice of apophenia, a term coined by Boyd and Crawford to describe the phenomenon of "seeing patterns where none actually exist, simply because enormous quantities of data can offer connections that radiate in all directions" (Boyd & Crawford, 2012, p. 668). Questions around how to interpret big data are controversial and continuously discussed. Nonetheless, big data has become a part of everyday life, and it lies at the center of the digital realm. Hence, big data also feeds into the ongoing transformation in the digital realm.

Normatively speaking, the public sphere is a communication space constituted by social interactions that serves as a framework for political discussions. According to leading thinkers in the field (amongst others Dahlgreen, 1995; Fraser, 1990; Habermas, 1990) the public sphere is central to a functioning democracy. In the digital realm mass audiences, mostly identified and critiqued by the Frankfurt school, fall apart into networked publics (Varnelis, 2008; Papacharissi, 2014) that arise as fast as they cease. Reconstructing the Twitter case #aufschrei Maireder and Schlögl (2014) conclude that today's publics have no fixed borders. They are formed ad-hoc, revolve around a specific topic and fall almost instantly apart. Because individuals are typically part of several networked discourses, communication in the digital realm flows horizontally between numerous discourses that take place simultaneously.

### (3) Convergence culture

According to cultural theorist Henry Jenkins (2006) another defining characteristic of the digital realm is the convergence of all media. Convergence means that what was formerly segregated now moves towards uniformity. The digital realm makes it possible to simultaneously listen to music, browse through the latest news and chat with friends. Different devices are not a necessity anymore. Jenkins (2006) elaborates:

> Media is more than simply a technological shift. Convergence alters the relationship between existing technologies, industries, markets, genres and audiences. Convergence alters the logic by which media industries operate and by which media consumers process news and entertainment. There will be no single black box that controls the flow of media into our homes. Thanks to the proliferation of

> channels and the portability of new computing and telecommunications technologies, we are entering an era where media will be everywhere. Convergence isn't something that is going to happen one day when we have enough bandwith or figure out the correct configuration of appliances. Ready or not, we are already living within a convergence culture. (p. 16)

Jenkins describes a cultural shift towards the ubiquity of media. This shift is also referred to as the process of mediatization[3]. Jenkins points out that digital media is more than a new technology. It alters production and consumption patterns. In this sense, algorithmic media can be understood as the outcome of convergence culture while simultaneously promoting and shaping it. Algorithmic structure has shaped this distinct form of media, which is also closely linked to changing consumption patterns. Within algorithmic media journalistic news content is not separate from user-generated content or advertising. This means that by default, all different types of content flow into the user's news stream, aggregated by algorithms.

Hogan (2010) defines algorithms in this regard as technological curators. Drawing on Goffman's (1959) performance theory, he distinguishes between exhibition and performance spaces; pointing out that a performance is a live act while an exhibition is an outcome from the past. Within exhibitions, artifacts are curated on behalf of the audience. A performance, on the other hand, comprises an event in a certain time frame. Therefore, performances are bound to their audiences in time and space while exhibitions can be visited independently of time. Hogan (2010) writes:

> One of the key distinctions between exhibitions and performances is that performances are subject to continual observation and self-monitoring as the means for impression management, whereas exhibitions are subject to selective contributions and the role of a third party. I refer to this third party as a curator that has the capacity to filter, order, and search content. The exhibition has its own logic, such as lowest common denominator culture and easy persistent friends that do not have direct analogs in offline life. (p. 384)

3 Amongst others, a perennial research project initiated by Stig Hjavard at the University of Copenhagen describes mediatization as "the process through which core elements of a social or cultural activity become influenced by and dependent on the media" (http://mediatization.ku.dk) (last access 21.07.2017).

Hogan describes an algorithm as a third party respectively as a curator. This role of the algorithm as a third party is what makes algorithmic media distinct from other forms of media. Algorithmic processes follow their own logic and therewith lead to unique exhibition spaces. Hogan's understanding is helpful insofar as it helps to underline the specific role of algorithms.

To summarize, the three brief descriptions of concepts show an increase of information and its constant availability, which for many has led to digital information overload. While in analog times newspapers were typically published once a day, today's news can be received second by second, which has led to fragmented information. The quantitative growth of information does not necessarily mean that we have more information or more detailed knowledge. However, it does mean that how information is handled has changed. Today's information is consumed by fast-changing networked publics. Further, information has become subject to quantitative measurement. This has lead to the emergence of the term big data and a range of debates that spring from it. Internet users constantly leave data traces, which are used for various kinds of analyzes. How the specific algorithmic processes play out will be explored in more detail in the next section.

## 2.2 A patent description of algorithmic media

To provide relevant information is one of the main objectives of the producers of algorithmic media. How this goal is put into practice remains generally vague. A closer reading of software patent WO2011033441 aims at shedding light on the interaction process between the algorithm and the user. The patent was published on March 17, 2011 in the US. It is called *syndicated data stream content provisioning* and shows the idea behind algorithmic media:

> Apparatus for syndicated data stream content provisioning, the apparatus comprising: an interaction tracker, configured to track at least one interaction of a user with at least one content object of a respective one of a group consisting of at least one syndicated data stream received on a computer device, the interaction being implicitly indicative of a preference of the user, a ranking function calculator, in communication with the interaction tracker, configured to calculate a ranking function based on the tracked interaction, and a content ranker, in communication with the ranking function calculator, configured to rank a plurality of content objects of the syndicated data streams of the group, in an order based on the calculated ranking function. (my6sense, patentscope[4])

The following drawing accompanies the patent and visualizes the process in more detail.

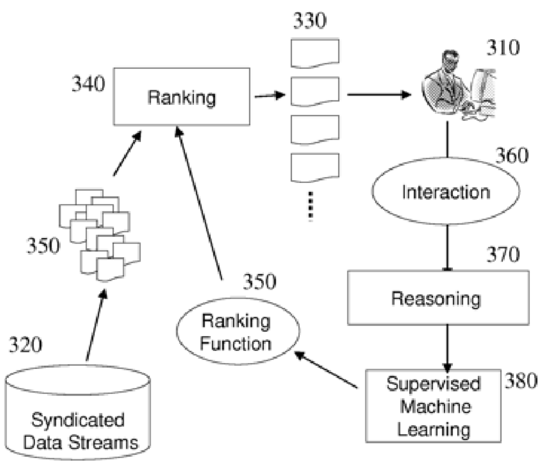



Figure 1: Apparatus for syndicated data stream (Retrieved from patentscope[5])

The figure is best read starting at [310], following clockwise. [310] in combination with [360] shows an interaction on a computer screen; this is the starting point: a user interacting with the computer. According to the interaction, in other words where the user has clicked, the reasoning function applies. Assuming the user has clicked on a cat picture and looked at it for a certain length of time, it is reasoned [370] that the user is interested in cat pictures. Supervised Machine Learning [380] registers this activity and "learns" this information about the user. This "knowledge" is saved in what is typically

4 http://patentscope.wipo.int/search/en/WO2011033441 (last access 21.07.2017)

5 http://patentscope.wipo.int/search/en/WO2011033441 (last access 21.07.2017)

called a user model. The model itself is not fixed but constantly enriched by new information the computer "learns". The information gained about the user is then applied via the ranking function [350]. The ranking function does not operate by itself but in relation to the user model:

> The ranking function is calculated using implicit feedback provided by the user, as the user interacts with content objects of syndicated data streams the user subscribes to (...). For example, a user who skips a first content object, opens a second content object, or sends en email sharing the second object with a friend, implicitly provides a feedback on the user's relative preference for the second content object over the first content object.

Additionally, syndicated data streams [320] are evaluated. This means trends on the internet are widely observed and are also fed into the final ranking function [340], the combination results in a list of ranked information [330]. Generally two types of feedback are distinguished: implicit feedback and explicit feedback. The latter is described as follows:

> In one example, the explicit preference interface is implemented as a graphical user interface, which allows the user to express his feeling towards a certain content object, say using a graphical radio button with two or more alternative options (say one positive, one negative, and one neutral), a check box, a text box, etc., as known in the art.[6]

The other form of feedback – implicit – is what raises public concern as it is less obvious. It is described as follows:

> For example, suppose that the user briefly goes over the ranked list 330 (i.e. of titles of content objects) and opens (i.e. requests the full content of) a content object ranked third from the top.
>
> The interaction of the user with the content object ranked third from the top of the ranked list 330 is interpreted as an implicit indication. The implicit indication is that under specific circumstances of the interaction 360 (such a specific moment or the user's location), the title of the third object is of a higher interest to the user than the title of first two objects. More generally, a user interaction 360

6 http://patentscope.wipo.int/search/en/detail.jsf?docId=WO2011033441&recNum=1&maxRec=&office=&prevFilter=&sortOption=&queryString=&tab=PCTDescription (last access 21.07.2017)

> may indicate a deviation of the user preferences over the content objects 350 presented to the user from the order in which the content objects are presented to the user in the ranked list 330.
>
> Other interactions 360, which implicitly indicate the user's preference over content objects may include, but are not limited to: a) relative time spent while consuming a content object, b) content-related activities performed in the scope of consuming an object (such as sharing the content with other users or consuming a business object annotating a content object), or any other implicit and explicit expressions of emotional attitude towards individual content objects, as described in further detail hereinabove.
>
> The interaction tracker 110 tracks the interactions 360 by monitoring, analyzing, and recording data of the interactions 360 (say in a dedicated database, as known in the art).[7]

The patent presented above describes how user data is recorded and analyzed. The most decisive factor is the user's actions with what is called in the patent "content object". A content object is a piece of information, for example a teaser or a link to a news article. Depending on the user interaction or lack of it, assumptions about the user are made. If, for example, the user clicks on the third headline, it is assumed that the first two headlines were of no relevance. Hence the content of the third object is analyzed and next time similar content is ranked first. During this process, not only is content object number three analyzed, but also number one and two, to learn more about the user. If number three was a music video while number one and two were sports articles, it is assumed that the user prefers music over sports. Therefore, next time the music video will be ranked first and sports articles second. As user behavior constantly changes, rankings are constantly adjusted. If at one point the user chooses a sports article over music, they will both be re-ranked accordingly. This clearly shows that user behavior and algorithmic structure are mutually responsive.

In conclusion, the patent shows basic considerations behind algorithmic media. What could be shown is the strong influence the user has on the algorithm's process, be-

7 http://patentscope.wipo.int/search/en/detail.jsf?docId=WO2011033441&recNum=1&maxRec=&office=&prevFilter=&sortOption=&queryString=&tab=PCTDescription (last access 21.07.2017)

cause all mathematical calculations are based on the user's actions. This makes algorithmic media even more inscrutable as the user typically does not know when and how feedback is recorded. In order to gain more knowledge about the feedback processes, the following section will look into self-descriptions on various producers' websites. These must be read with a critical eye as they are not technical descriptions as the patent but marketing blurbs, designed to present the service in the best possible light. However, they can still provide valuable insight and I will therefore examine them in further detail.

## 2.3 The operation mode of algorithms through a marketing lens

After having situated algorithmic media in the context of the digital realm and illustrated its functionality through a patent description, the following table 2 lists examples of mission statements and product descriptions of general algorithmic media platforms. The services were selected according to number of users. A high user number indicated a certain usage and popularity. The list is not exclusive examples that serve as a reference point. The descriptions are taken directly from the services' websites and are therefore formulated in the companies' own words. This contributes to a deeper understanding of algorithmic media insofar as the descriptions make for an interesting contrast with the journalistic discourse laid out in the introduction. Of particular salience is the rhetoric used, which clearly follows a marketing logic. This means the language is shaped towards reaching a target audience. Typically, marketing specialists target an audience in order to reach specific organizational goals. Therefore, it can be assumed that the descriptions do not reflect the operation mode of algorithmic media in a strictly technical and accurate sense. However, it is still insightful as it presents the companies' own angles on their products. The table represents seven examples of self-descriptions of popular services. As noted in the introduction algorithmic media is defined by its inherent process of creating information relevance through algorithmic procedures.

| About/Mission statement | Description of algorithmic procedures |
|---|---|
| *Facebook (News Feed)* | |
| Give people the power to build community and bring the world closer together. (Facebook "About", 2017) | *How does News Feed decide which stories to show?*<br>The stories that show in your News Feed are influenced by your connections and activity on Facebook. This helps you to see more stories that interest you from friends you interact with the most. The number of comments and likes a post receives and what kind of story it is (ex: photo, video, status update) can also make it more likely to appear in your News Feed. (Facebook Help Center, 2017) |
| *Twitter (Top Tweets)* | |
| To give everyone the power to create and share ideas and information instantly, without barriers. (Twitter Mission, 2017) | When you search on twitter.com and on the Twitter for iOS and Android apps, you can filter your results by clicking or tapping Top, Latest, Accounts/People, Photos, or Videos (located at the top of your search results). Selecting Top shows Tweets you are likely to care about most first.<br>Note: Top Tweets are selected through an algorithm, we do not manually curate search results. (Twitter FAQ, 2017) |
| *News360 (News360 Feed)* | |
| News360 is an app that learns what you enjoy and finds stories you'll like around the web. (News 360, 2017) | *Personalize*<br>News360 picks what you are interested in and presents it in a beautiful way.<br>*Stay on top of information*<br>Most important news from 100,000+ sources at your fingertips.<br>*Customize*<br>Tailor News360 to your interests by choosing from 1M+ topics.<br>(News 360, 2017) |
| *Newsprompt* | |
| Discover breaking news and trending stories from around the web with our state of the art Google Chrome Extension. (Newspromt, 2017) | *Personalized Recommendations*<br>Newsprompt scans over 2000 top websites to recommend personalized content that user *(sic!)* will like to read and share. (Newsprompt, 2017) |

| About/Mission statement | Description of algorithmic procedures |
|---|---|
| *Flipboard (Cover Stories)* | |
| At a time when society could really benefit from being more informed and inspired, we are enabling great stories to reach the right communities around the world. (Flipboard Mission, 2017) | Cover Stories is the best of everything you follow, pulling content from all of the magazines, topics, and sources (e.g. people, publishers, and social) you already follow into one magazine. If you haven't followed much yet, we may fill it with recommended content. (Flipboard FAQ, 2017) |
| *Tame (Online Feed)* | |
| Our mission is to tame the wealth of real time information in social networks so as to empower people to make sense of the world. (Tame, 2017) | *You're talking about relevant content but how do you measure relevancy?* As with all things algorithm *(sic!)* – we can't go into the deepest details but we can tell you that we measure relevancy by the spread of mentions. So rather than the number of retweets we focus on the diversity and quality of sources. Of course we continuously finetune our algorithm and will announce major improvements on our blog. Also we're always happy to receive feedback and suggestions from you – our users. (Tame, 2017) |
| *Feedly (Online Feed)* | |
| You are in control – More signal, less noise (Feedly, 2017) | *Your Feeds*<br>Crunch through more content in less time by organizing your sources into easy-to-read feeds. |

Table 2: Examples of self-descriptions of algorithmic media

The examples in the table do not follow a specific order. They are meant to show how influential applications frame their algorithms. It is important to note that the table is not a systematic compilation of all algorithmic media available. However, the examples give an insight into the self-description of algorithmic media producers.

The first two examples, *Facebook* and *Twitter*, are still the two best-known and most widely used examples of algorithmic media services. Both have a wide network of users. While Twitter was able to establish a reputation as the fastest source of news, Facebook has become both a personal networking platform and a tool for organizations. Both write in their mission statement that their aim is to help people share information, which shall contribute towards connecting people in the world. This suggests a belief that people connect through information. It is Facebook's goal to connect family and friends; Twitter's focus lies on sharing information across established technological and social borders. While in Facebook and Twitter users create and share information within the network, *News360* systematically crawls the internet for relevant content. Hence, News360's mission statement points towards the individual user. It states that its service is created to learn about the user and, based on this learning, to provide information relevant to them. *Tame* and *Newsprompt* work much like News360 but its marketing focus is on organizing and structuring real-time information. Newspromt's description includes the notion of recommendation. The term recommendation has become widely known via Amazon; one of the first internet sites to employ algorithms designed to offer products based on users' previous purchases.

The description of how these algorithms work is rather vague on all counts. On Facebook's help page the question "How does News Feed decide which stories to show?" is answered with "The stories (...) are influenced by your connections and activity on Facebook". Here a strong dichotomy between algorithmic structure in the form of News Feed ("How does News Feed decide?") and the user ("The stories are influenced by your connections ...") becomes obvious. On the one hand, it seems like the News Feed "decides", while on the other it fundamentally depends on the user's actions and connections. This can be interpreted as another indication of the importance of the algorithm-user relationship. Twitter uses the term algorithm in its description and explains that the Tweets listed on top are there because they are favored by a wider community. This shows once more the importance of user behavior. They also write that if certain Tweets are not shown they might not be part of a wider conversation, which means that these Tweets are not liked or shared widely. What exactly "widely" means remains unclear. News360 writes that it "picks" information without any further explanation of how that process takes place. This description may give an impression of randomness. On the contrary, Tame refers in this case to a measurement of relevancy. Their algorithms are built to assign a measurement of relevance to a user's action. While all these descriptions focus on the technology itself, Feedly writes that they "crunch through more content in less time".

To focus on the individual user's interests and match the content to those interests is what distinguishes algorithmic media from journalism. As this brief summary of the descriptions shows, the goal is not to provide topics of general societal interest but to provide information that is tailored specifically to a unique individual. The user's interests are identified by tracing their online behavior. Through doing this, data on individual user behavior is accumulated and general discussions on the internet are monitored. The previous table has highlighted how important user behavior is in the processes of algorithms. In the following section, I describe the mathematics of algorithms as complex formulas.

## 2.4 A mathematical perspective on algorithms

As stated in the introduction, algorithms originated in the field of mathematics, and have since come to be applied in the field of computer science, specifically in the areas of information retrieval and artificial intelligence. One of the best-known authors in the field of algorithms is Donald Knuth, who published a multivolume book series on *The Art of Computer Programming*. Knuth (1981) is specifically honored for his contribution to the analysis of algorithms. In the preface to the second volume he writes:

> Each algorithm not only computes the desired answers to a problem, it also is intended to blend well with the internal operations of a digital computer. In many cases a person will not be able to appreciate the beauty of such an algorithm unless he or she also has some knowledge of a computer's machine language; the

efficiency of the corresponding machine program is a vital factor that cannot be divorced from the algorithm itself. The problem is to find the best ways to make computers deal with numbers, and this involves tactical as well as numerical considerations. Therefore the subject matter of this book is unmistakably a part of computer science, as well as of numerical mathematics. (p. V)

As Knuth states, algorithms are computer instructions carried out through specific programming languages. They are designed to respond efficiently to a defined problem. Efficiency in this case refers to calculation speed, in other words the longer a computer takes to calculate a problem the less efficient the algorithm is. So algorithms are used to solve problems with the help of computers. Below I present an example of an algorithm that is designed to generate random numbers. It starts with a problem description, followed by instructions for the computer:

Given a 10-digit decimal number X, this algorithm may be used to change X to the number that should come next in a supposedly random sequence.

**K1.** [Choose number of iterations.] Set $Y \leftarrow \lfloor X/10^9 \rfloor$, the most significant digit of $X$. (We will execute steps K2 through K13 exactly $Y+1$ times; that is, we will apply randomizing transformations a *random* number of times.)

**K2.** [Choose random step.] Set $Z \leftarrow \lfloor X/10^8 \rfloor \bmod 10$, the second most significant digit of $X$. Go to step $K(3+Z)$. (That is, we now jump to a *random*

**K3.** [Ensure $\geq 5 \times 10^9$.] If $X < 5000000000$, set $X \leftarrow X + 5000000000$.

**K4.** [Middle square.] Replace $X$ by $\lfloor X^2/10^5 \rfloor \bmod 10^{10}$, i.e., by the middle of the square of $X$.

**K5.** [Multiply.] Replace $X$ by $(1001001001\,X) \bmod 10^{10}$.

**K6.** [Pseudo-complement.] If $X < 100000000$, then set $X \leftarrow X + 9814055677$; otherwise set $X \leftarrow 10^{10} - X$.

**K7.** [Interchange halves.] Interchange the low-order five digits of $X$ with the high-order five digits, i.e., $X \leftarrow 10^5(X \bmod 10^5) + \lfloor X/10^5 \rfloor$, the middle 10 digits of $(10^{10}+1)X$.

**K8.** [Multiply.] Same as step K5.

**K9.** [Decrease digits.] Decrease each nonzero digit of the decimal representation of $X$ by one.

**K10.** [99999 modify.] If $X < 10^5$, set $X \leftarrow X^2 + 99999$; otherwise set $X \leftarrow X - 99999$.

**K11.** [Normalize.] (At this point $X$ cannot be zero.) If $X < 10^9$, set $X \leftarrow 10X$ and repeat this step.

**K12.** [Modified middle square.] Replace $X$ by $\lfloor X(X-1)/10^5 \rfloor \bmod 10^{10}$, i.e., by the middle 10 digits of $X(X-1)$.

**K13.** [Repeat?] If $Y > 0$, decrease $Y$ by 1 and return to step K2. If $Y = 0$, the algorithm terminates with $X$ as the desired "random" value. ▮

Figure 3: Algorithm K ("Super-random" number generator) (Knuth, 1981 p. 4-5)

The initial mathematical problem described is that a seemingly random number should follow a given 10-digit decimal number X. The question is: can a calculated number be a random number or how can it seem random? For the average person this problem might seem unsolvable, however, within the framework of mathematical calculations Knuth shows that it can be solved. He advises that "*random numbers should not be generated with a method chosen at random*" (p. 5, emphasis in the original). This example is relevant for the research because the idea that an item can simultaneously be random *and* calculated seems hardly imaginable from a social science perspective.

In the case of algorithmic media, algorithms are specifically employed for information retrieval. Information retrieval deals with the organization and management of information. In particular, it is "concerned with search processes in which a user needs to identify a subset of information which is relevant for his information need within a large amount of knowledge" (Mandl, 2009, p. 151). While the algorithm described above is used to solve a random-number problem, the problem statement in the area of information retrieval is to find information that matches a specific query; in the case of algorithmic media, this is the user's interest.

Information retrieval combines methods of ranking, methods of indexing and methods of knowledge representation. A general problem computer scientists face today is that machines are as yet unable able to process natural language. This means human information must be translated into a machine-readable format. In the translation process, typical semantic problems arise such as one word having more than one meaning. While humans can easily learn to distinguish between these meanings, this is still a major issue in computer programming.

Processing natural language is a complex problem for producers of algorithmic media. Categories like, for example, politics are human categories which the computer cannot understand per se. This is why one of today's major strategies for solving this problem is to monitor user behavior and use those results to draw conclusions about the relevance of information. If a piece of information is shared and "liked" by a relatively high number of users, it is assumed that this information is important. The actual content of the information plays a secondary role here. This is an important insight into programming as algorithmic media is often evaluated against the content it provides within public discourse. However, as argued, the content itself plays a subordinate role within the process of creating information relevance in algorithmic media at this point of technological development.

## 2.5 Conclusion

At the start of the chapter I outline three concepts that are to my understanding crucial when studying algorithmic media. The concept of digital information overload arises from the notion of information overload introduced by Alvin Toffler. Digital information overload has gained importance since sharing, tagging and liking have become everyday practices. Digital information is highly interconnected and is therefore often perceived as an endless stream of information. However, when searching for a specific piece of information sometimes the opposite occurs. Then, it is a case of finding the famous needle in the haystack. The second concept presented is big data. Users constantly leave data traces in the digital realm and accumulated data has become famous under the name 'big data'. Many companies have begun to commercially exploit the ubiquity of data, which has led to controversial discussions of what big data analysis can provide. The third concept discussed is that of convergence culture. According to theorist Henry Jenkins, the term convergence refers to a flow of content across different media platforms. The concept entails a shift from a passive mass audience towards a participatory culture. Participatory culture means an audience that is actively involved in the creation and distribution of media content. The three concepts; digital information overload, big data and convergence culture; have been described to illustrate the digital context in which algorithmic media sits.

After describing the context, which algorithmic media is simultaneously embedded in and draws on, a close reading of a software patent follows. The examination of the software patent highlights the importance of the algorithm-user relationship. It shows that information is presented in accordance with user behavior, and underlines the significance of user behavior when it comes to algorithmic media.

Then I summarize marketing descriptions of a few competing algorithmic media platforms, which further underlines the duality of algorithmic media: on the one hand, algorithms are described as automatic processes, while on the other hand the importance of the user is made clear. Algorithmic media can be understood threefold. Firstly, it is a technical solution which manages digital information overload. Secondly, it is utilized to understand users' interests and tailor information accordingly. Thirdly, it fosters a convergence culture because different forms of information – written words, sound, pictures and video – are presented within the same feed; and because individuals have the means to create and share news themselves.

In the final section I elaborate on the mathematical foundations of algorithms. In current discourse the term algorithm is often left undefined, or simplified as step-by-step instructions. An inquiry into the mathematical foundations showed that this cursory understanding lacks exploratory power when it comes to algorithms-in-practice.

Therefore, within this research I understand the outcome of algorithmic media as a co-creation process of algorithms and their users. In this understanding it is not solely the algorithm that "decides" the outcome but the relationship of algorithm and user that constitutes information relevance in algorithmic media.

# 3. Information relevance as algorithm-user-communication

Algorithmic media has become popular through its widespread use as a daily information source, while at the same time leading to a consumer mindset that most experts in the field find alarming. Supposedly, today young users follow the motto: "If the news is that important, it'll find me" (Benton, 2014). People just sitting back and waiting for news is in contrast with traditional ideas of news consumption. This development of news 'finding its readers' rather than the other way around highlights once again the pertinence of the overall research question and its relevance in modern democratic societies. In the previous chapter I presented the backdrop towards answering the overall research question. By drawing on a close study of a software patent, a brief analysis of marketing descriptions, and a short inquiry into the mathematics of algorithms, I have demonstrated that user behavior plays a far greater role than current research and inquiries acknowledge. Furthermore, it has been shown that algorithms in the digital context are far more complex than existing theoretical definitions reflect. Based on these insights, I will now develop a conceptual framework that guides and frames the following empirical analysis.

As addressed in the previous chapter, a major challenge in formulating the conceptual framework lies in the duality of algorithmic media. This means that the technological as well as the social use of algorithmic media needs to be taken into account. At a first glance the concepts of technology and sociality seem contradictory, however, especially through the advancements in the field of artificial intelligence both sectors have started to move closer together. Traditionally, within digital media and communication studies computers have been conceptualized as a medium through which humans communicate and interact[8]. This theoretical perspective originates from functional engineering theories such as Shannon and Weaver's mathematical model of communication as well as more general system theories. In the functional approach communication is transmitted from sender to receiver; in this perspective the computer is a technical throughput device. Media scholar Gunkel objects to this established idea of computer-mediated communication and advocates a paradigm shift in the field of digital media and communication science. Specifically, he argues for an understanding of the computer as a "communicative other" (Gunkel 2012, p. 21). In Gunkel's perspective computer technology is more than a solely technical device; on the contrary, in his view computers are active communicators calling their users to action. To my knowledge, Gunkel has been the first author to address specific conceptual issues arising from the emergence of artificial intelligence in digital media. Hence, the conceptual framework that guides this research will refer to Gunkels notion of computers as 'communicative others'. More specifically, I argue for conceptualizing algorithms and users as communicative others.

The equal treatment of both – algorithms and users – as communicative others aims to overcome the distinct notion of algorithms as technology and users as social beings in the digital realm. The conceptual framework draws on a comparatively young research tradition called communication-as-a-constitute (abbreviated as CCO). The CCO approach emerged from the field of organizational theory and understands organizations and systems as communicative phenomena. Theorists in the CCO field agree on the notion that it is the communicative processes that constitute systems. In the CCO understanding, communication is not merely a function in a system but plays an active role in constituting systems. Adopting a CCO view on algorithmic media offers a

8 For a quick overview on these questions see also Morris and Ogan's (1996) article published in the Journal of Computer-Mediated Communication. Examining the internet as a medium of mass communication they write: "In creating new configurations of sources, messages, and receivers, new communication technologies force researchers to examine their old definitions. What is a mass audience? What is a communication medium? How are messages mediated?" (para. 8).

valuable and distinct research perspective towards studying algorithmic media: one of algorithm-user-communication. By focussing on the communicative relation of algorithms and their users, the aim is to contribute towards an understanding of algorithmic media, that reaches beyond the explanatory framework of algorithms as functional systems and mechanical step-by-step instructions.

Before the conceptual framework is developed, I will first place this research on algorithmic media in the broader field of internet studies. Within the field of internet studies various digital phenomena have been investigated and therefore it is useful to review influential literature in this area. According to its structure this thesis is a social science study, however, it relates to a specific digital phenomenon. Therefore reviewing literature in the field of internet studies seems valuable. After placing this research in the field of internet studies, I will introduce current understandings of algorithms through the lens of functional systems theory. As a preliminary summary, I will discuss the input-throughput-output model proposed by Latzer et. al (2014) as an example of how functional theories motivate current understandings of algorithms. Then, I will introduce the communicative perspective that guides this research. In conclusion, I will present the final conceptual framework that provides a lens for the empirical analysis.

## 3.1. The field of internet studies and key perspectives on technology

This research takes a explorative approach by understanding algorithmic media as a digital phenomenon. According to the proposed goal of this research, which is to study how information relevance arises in algorithmic media, the formulation of a cross-disciplinary ground seems most beneficial. Generally speaking, this research may take place in the field of computer science as well as digital media studies. Research in the area of computer science and engineering mostly aims to support design, development and advancement in technology. The assessment of the social implications of technology is mostly carried out in the field of social science and the humanities. Currently, both are rather separated fields of research; only recently have they started to grow closer together. To my understanding, the distinctive fields of computer and digital media science have led to terminological misconceptions. As shown in the previous chapter the theoretical definition of algorithms does not sufficiently describe its practical counterparts. In order to overcome this computer/social science gap and to allow a certain openness, I place this exploration under the umbrella of internet studies. According to the Association of Internet Researchers (AoIR) the field of internet studies is concerned with the internet as a "social phenomenon, a tool, and also a (field) site for research" (Markham and Buchanan, 2012):

> Depending on the role the internet plays in the research project or how it is conceptualized by the researcher, different epistemological, logistical and ethical considerations will come into play. The term "Internet" originally described a network of computers that made possible the decentralized transmission of information. Now, the term serves as an umbrella for innumerable technologies, devices, capacities, uses, and social spaces. (p. 3)

In the past ten years the internet has become subject to several alternative understandings, interpretations and conceptualizations. While in the beginning the internet was mostly understood in a technical sense as an interconnected network, today there are numerous descriptions of the internet. Based on the above explanation, the AoIR Ethics Working Committee (Markham and Buchanan, 2012, p. 3-4) distinguishes between seven forms of internet research:

> Internet research encompasses inquiry that:
>
> (a) utilizes the internet to collect data or information, e.g., through online interviews, surveys, archiving, or automated means of data scraping;
> (b) studies how people use and access the internet, e.g., through collecting and observing activities or participating on social network sites, listservs, web sites, blogs, games, virtual worlds, or other online environments or contexts;
> (c) utilizes or engages in data processing, analysis, or storage of datasets, databanks, and/ or repositories available via the. *(sic!)*

(d) studies software, code, and internet technologies.
(e) examines the design or structures of systems, interfaces, pages, and elements.
(f) employs visual and textual analysis, semiotic analysis, content analysis, or other methods of analysis to study the web and/or internet-facilitated images, writings, and media forms.
(g) studies large scale production, use, and regulation of the internet by governments, industries, corporations, and military forces.

This research is concerned in particular with inquiries in sections (b) and (d). Concretely, it is concerned with algorithmic media from a technological as well as a social perspective. By looking at both technological as well as social factors, the aim of this research is to develop a model that takes both the technological structure and social usage into account (see chapter 6). As mentioned earlier, in a broader sense this research is still a social science study, however, the specific phenomenon of algorithmic media takes places and is motivated by digital infrastructure. That is why I place this research under the umbrella of internet research.
Having placed this exploration in the field of internet research, I will now outline key literature in relation to the studied phenomenon of algorithmic media. It is important to note that this is not a comprehensive list of literature in the field but an outline of influential literature in relation to this research. The following literature review is divided into three areas: the social construction of technology (see section 3.1.1), technological affordances (see section 3.1.2) and algorithms and society (see section 3.1.3).

### 3.1.1 The social construction of technology

The main question of this theoretical inquiry is how to conceptualize algorithmic media. One prominent conceptual view on technology is based on the epistemology of social constructivism. Research in the field of the social construction of technology (abbr. as SCOT) is primarily concerned with the development of technology. Technological artifacts in the understanding of the SCOT framework are not just objects in themselves[9] but objects created by social actors. This means software can only be understood through the study of the creators themselves. Furthermore, technological artifacts are not understood as the "best" possible version but as highly dependant on social and contextual factors. Therefore, when researching technology it is important to reflect on the entangled socio-historical roots.

> In SCOT the developmental process of a technological artifact is described as an alternation of variation and selection. This results in a "multidirectional" model, in contrast with the linear models used explicitly in many innovation studies and implicitly in much history of technology. (Pinch and Bijker, 1987, p. 28)

The SCOT framework by Pinch and Bijker was established in opposition to earlier linear models explaining innovation processes in technology. One of the most cited articles that lays out the SCOT framework in more detail is the essay *The Social Construction of Facts and Artifacts* by Bijker and Pinch (1987). Therein Bijker and Pinch trace the development of the Penny Farthing bicycle, which eventually results in a multidirectional description of relevant social groups, problems, and solutions during the development process of the bicycle. Pinch and Bijker demonstrate that technology is not only subject to a linear development process but to "growing and diminishing degrees of stabilization of the different artifacts" (p. 39). They write:

> By using the concept of stabilization, we see that the "invention" of the safety bicycle was not an isolated event (1884), but a nineteen-year process (1879-98). For example, at the beginning of this period the relevant groups did not see the "safety bicycle" but a wide range of bi- and tricycles – and, among those, a rather ugly crocodilelike bicycle with a relatively low front wheel and rear chain drive (...). By the end of the period, the phrase "safety bicycle" denoted a low-wheeled bicycle with rear chain drive, diamond frame, and air tires. As a result of the stabilization of the artifact after 1898, one did not need to specify these details: They were taken for granted as the essential "ingredients" of the safety bicycle. (p. 39)

9 Kant (1913) distinguishes in his philosophy *Kritik der reinen Vernuft* between the thing-in-itself ("das Ding an sich") and the phenomenon, which is how the thing-in-itself appears to the observer. Hence, the description of an artefact depends on the perspective. The SCOT framework advocates for a social-historical perspective.

This citation shows that technology can not only be regarded as an ontological object but also as a social construction. Orlikowski (1992), one of the most influential thinkers in the field of organizational studies, calls this the "duality of technology". She motivates her research as follows:

> Technology has always been a central variable in organizational theory, informing research and practice. Despite years of investigative effort there is little agreement on the definition and measurement of technology, and no compelling evidence on the precise role of technology in organizational affairs. (...) What is needed is a reconstruction of the concept of technology, which fundamentally re-examines our current notions of technology and its role in organizations. (p. 398)

Taking this statement as a starting point Orlikowski presents later in her text a structurational model of technology that draws on Giddens' theory of structuration and sheds light on the ontological as well as social side of technology. Social theorist Anthony Giddens is well-known for his work on overcoming the duality of agent and structure by introducing the concept of 'structuration' (see figure 4). Giddens (1984) shows that social practices are situated in space and time, being neither "the experience of the individual actor, nor the existence of any form of societal totality" (p. 2). He argues that studies in general tend to focus on either agent or structure and that these views are too narrow, and their exploratory power limited. Therefore, Giddens offers an integrated view that takes the actor as well as structure into account. Giddens claims social practices can then be explained over time. Agents, structure, and the duality of structure are the three major components of his theory. Describing the actions of the agent, Giddens writes:

> [A]ctors not only monitor continuously the flow of their activities and expect others to do the same for their own; they also routinely monitor aspects, social and physical, of the context in which they move. (p. 5)

The function of structure is then:

> the 'binding' of time-space in social systems, the properties which make it possible for discernibly similar social practices to exist across varying spans of time and space and which lend them 'systemic' form. (p. 17)

Giddens defines structure by the "absence of the subject" (p. 25) and agents by their involvement in generating that structure. He argues that structure reproduces and maintains itself through social and system integration. The concept of system integration refers to actors who are present in the same system at the same point in time. The duality of structure signifies then that "structural properties of social systems do not exist outside of action but are chronically implicated in its production and reproduction" (p. 374).

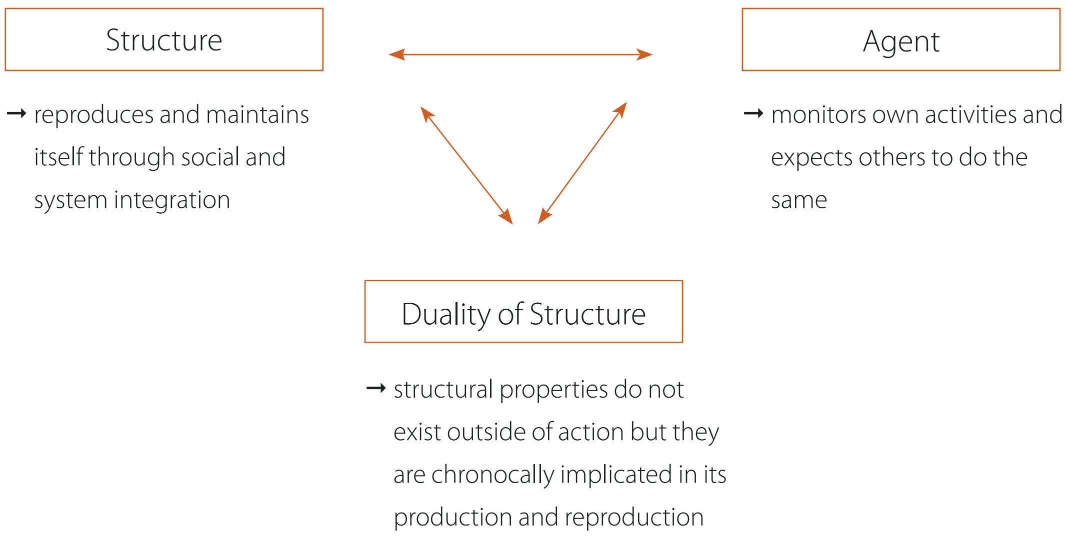



Figure 4: Giddens structuration theory (own figure)

Orlikowski (1992) transfers Giddens thought on the duality of structure onto technology by stating that "[t]echnology is created and changed by human action, yet it is also used by humans to accomplish some action" (p. 405). This dualistic approach towards technology integrates former dichotomic views:

> The duality of technology identifies prior views of technology – as either objective force or as socially constructed product – as a false dichotomy. Technology is the product of human action, while it also assumes structural properties. That is, technology is physically constructed by actors working in a given social context, and technology is socially constructed by actors through the different meanings they attach to it and the various features they emphasize and use. (Orlikowski, 1992, p. 406)

The notion of duality has received wide attention in the field of science and technology studies. The earlier described study of Pinch and Bijker is pioneering in its showing how technological artifacts are not always the best feasible solution but dependent on a number of influencing factors. Tracing the development of the Penny Farthing bicycle Pinch and Bijker showed that the technological development process can not solely be explained through the lens of successful versus failed solutions but as a year-long process. Hence, when explaining the development of technology, both the relationship between social groups and how problems are perceived in these groups and the various possible solutions need to be taken into account. Pinch and Bijker's study has been one of the first studies to overcome linear models of explanation in favor of complex heuristics and thus, has had a decisive influence in the current field of technology studies.

This research on information relevance in algorithmic media builds on the insights from the duality of technology. Even though algorithmic media might be perceived as an ontological object it is important to inspect its socio-historical roots and preforms. Several social and technological factors have influenced and will continue to influence current algorithmic services. Algorithmic media needs consequently to be studied as an object-in-flux because algorithmic performance is constantly changing. Hence, algorithms lack consistent material structure. In contrast to hardware such as computer screens, algorithmic media does not appear in the same structural form over a fixed time period. This constant state of flux is what makes algorithmic media a challenging, albeit compelling, study object and furthermore calls for an open conceptual framework.

### 3.1.2 Technological affordances

A concept widely used in the field of internet studies to explore and analyze technology is that of technological affordances. The concept of affordance is situated at the intersection of technological determinism and the aforementioned social constructivist view of technology. Advocates for the technological deterministic view suppose that technology primarily changes human behavior and thus affects humans deterministically. Advocates for the social constructivist view argue that technology is primarily subject to social construction. The concept of affordance is utilized to combine both perspectives. Baym (2010) states:

> If technological determinism locates cause with the technology, and social constructivism locates cause with people, a third perspective, sometimes called social shaping, emphasizes a middle ground. From this perspective, the consequences of technologies arise from a mix of "affordances" – the social capabilities technological qualities enable – and the unexpected and emergent ways that people make use of those affordances. (p. 44)

The original concept of affordance was coined by psychologist James Gibson and is central in his ecological approach to psychology. In his earlier writings Gibson (1966) proposed an understanding of the experience of perception in a perceptual systems framework. Until Gibson's proposal, the process of perception was understood as channels of sensation. Based on his initial idea of perceptual systems, Gibson (1979) developed in his later writings the theory of affordance, which studies the behavior of humans and animals based on their perception of the environment. Through this, Gibson has been one of the first writers to examine the relationship of animals and their environment based on the notion of perception. He presents his theory via the following example:

> If a terrestrial surface is nearly horizontal (instead of slanted), nearly flat (instead of convex or concave), and sufficiently extended (relative to the size of the animal)

> and if its substance is rigid (relative to the weight of the animal), then the surface *affords support*. It is a surface of support, and we call it a substratum, ground, or floor. It is stand-on-able, permitting an upright posture for quadrupeds and bipeds. It is therefore walk-on-able and run-over-able. It is not sink-into-able like a surface of water or a swamp, that is, not for heavy terrestrial animals. Support for water bugs is different.
>
> Note that the four properties listed – horizontal, flat, extended, and rigid – would be *physical* properties of a surface if they were measured with the scales and standard units used in physics. As an affordance of support for a species of animal, however, they have to be measured *relative to the animal*. They are unique for that animal. They are not just abstract physical properties. They have unity relative to the posture and behavior of the animal being considered. So an affordance cannot be measured as we measure in physics. (emphasis in the original, Gibson 1986, 2013, p. 127-128)

In this citation Gibson describes the nature of the relationship between an animal and its environment. He declares that physical properties of the environment become relative in relation to how the animal perceives them. From the perception of water bugs water has the property "to hold". From the perception of heavier animals, water, however, does not have the same property. Therefore, environmental properties depend on the observer's perception – an insight that seems almost trivial today but was pioneering in Gibson's time.

Since then the concept of affordance has been used to describe and examine the relativity of physical objects. Norman (1988) writes that the specific design of door handles suggests different forms of action. Depending on the setting of the handle, horizontal or vertical, it either afforts pushing or pulling the entire door or just pushing the handle and then opening the door. The concept of affordance has recently been applied to the design of digital interfaces. Gaver (1991) points out that interfaces are rather complex and depend on the user's culture, experience and knowledge. His simple but surprising question "Do scrollbars afford scrolling?" (p. 81) points to the peculiarities of interfaces and their social construction. While it can be argued that a rural environment has physical affordances independent of humans per se, digital technologies are always created by humans and therefore bound to the social. On this basis, Gaver suggests that the notion of affordances must be extended by exploring the term. He points out that to passively observe an interface might not result in corresponding conclusions. Therefore, Gaver introduces the concept of "tactile affordances" (p. 82); affordances that can be perceived by other senses than the visual. He writes:

> Similarly, input devices may make use of tactile affordances. For instance, pressing onscreen buttons is reinforced by pressing mouse buttons, and force-feedback joysticks allow users to feel simulations. We might imagine redesigning three button mice with two of the buttons on the sides; this would offer the affordances of squeezing and pushing. (p. 82)

In the field of digital media and communication studies the concept of affordance is mostly used to examine structural properties. In the glossary of Lister et al. (2008) *New Media: A Critical Introduction* the concept of affordance is defined as:

> The term 'affordance' derives from design theory. It refers to the possible ways in which artefacts and materials can be used, the actions or processes they facilitate. Affordances are determined primarily by physical properties, shape and scale of artefacts, rather than their cultural significance or meanings. (p. 418)

In a recent text Nagy and Neff (2015) argue for the term 'imagined audiences', which points towards the mediated duality of the users' perceptions and digital material. Nagy and Neff point out that the term affordance, even though widely used in the field of technology studies still lacks a clear definition. Hence, they offer the following:

> Users may have certain expectations about their communication technologies, data, and media that, in effect and practice, shape how they approach them and what actions they think are suggested. These expectations may not be encoded hard and fast into such tools by design, but they nevertheless become part of the users' perceptions of what actions are available to them. This is what we define as imagined affordance, as opposed to a more rigid and fixed notion of affordance that communication technology scholars have struggled with.

In conclusion, it is important to note that digital affordances depend on the user's perception, implicit knowledge and experiences and that technological affordances can be interpreted in very different ways. While a technologist or programmer might design a website or service in a particular way, the user may use the product very differently than the technologist or programmer had intended. This is where digital and physical objects differ considerably. While nowadays, the affordance of a chair to allow the action of sitting is relatively straight forward, digital affordances are still subject to negotiation. Digital affordances vary depending on the user and his social context.

### 3.1.3 Algorithms and society

After examining the social construction of technology and the concept of affordance I now elaborate on influential literature on a societal level. In the field of social science, current literature on algorithms is manifold and cluttered. A first comprehensive list of what it called 'critical algorithm studies' was made by researchers from the Social Media Collective (Gillespie and Seaver, 2015). At the core of the discussion stands the contested term 'algorithm' as emphazised by Barocas, Hood and Ziewitz (2013):

> Algorithms have developed into somewhat of a modern myth. They "compet[e] for our living rooms" (Slavin 2011), "determine how a billion plus people get where they're going" (McGee 2011), "have already written symphonies as moving as those composed by Beethoven" (Steiner 2012), "allow self-determined action on the Internet but also contain aspects of control over this action" (Institute for Media Archeology 2011), and "free us from sorting through multitudes of irrelevant results" (Spring 2011). How do they do all this, and more? What exactly are algorithms "doing," and what are the implications? Can an algorithm "do" anything? And who or what are "algorithms" anyway? (para. 1)

To my knowledge, comprehensive systematic literature on the intersection of algorithms and society is currently lacking. Due to the recency of the discussion, this is not surprising. However, articles, essays and thoughts on the subject can be found on the

Social Media Collective blog as mentioned above. The academic field of search engine research seems slightly further progressed in this respect. In her PhD titled "Search engine bias" van Couvering (2009) reviews literature on search engines following earlier systematizations by Machill, Beiler and Zenker (2008). She includes issues raised by Halavais (2009) and organizes the field of search engine research into (1) Information retrieval, (2) Information literacy, (3) Media economics and online marketing, (4) Search engine effects and (5) Search engines and society. This classification shows the versatility of the topic and it is likely that literature on algorithms falls into similar fields. Therefore, I will not further elaborate on those fields and will instead point to van Couvering's overview.

In the following, I present and discuss literature that has strongly contributed to the emergence of critical algorithm studies, namely Lessig's idea of code is law, Berners-Lee's thoughts on hypertext, Castell's analysis of power in network structures and Gillespie's ideas on the public relevance of algorithms. The common core of this literature is their interest in the social implications of algorithmic processes in modern democracies. A starting point for these investigations is the influential role of the internet in relation to democracy. One of the first writers who raised awareness about the structuring force of software is Lawrence Lessig. In the book *Code: And other laws of cyberspace* Lessig (2000) argues that code architecture regulates cyberspace.[10] He points out that typically social norms, constitutional laws and market dynamics regulate human behavior; now, on the internet, additionally code[11] regulates human behavior (see figure 5).

10 Lessig refers to the internet as cyberspace.

11 Lessig uses code and architecture interchangeably.

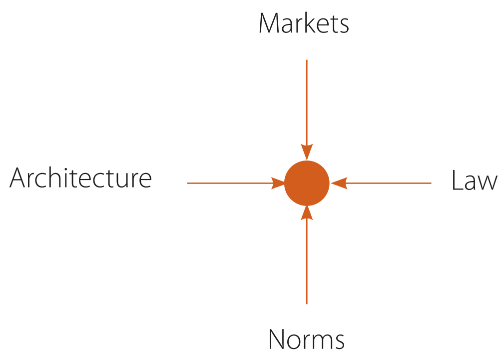



Figure 5: Regulatives on the internet (cf. Lessig, 2000, p. 88)

Lessig (2000) writes that the dot in the middle of the figure represents a person who is using the internet – behaves under constraints. With regards to the constrains he explains:

> The constraints are distinct, yet they are plainly interdependent. Each can support or oppose the others. Technologies can undermine norms and laws; they can also support them. Some constraints make others possible; others make some impossible. Constraints work together, though they function differently and the effect of each is distinct. Norms constrain through the price that they exact; architecture constrain through the physical burdens they impose; and law constrains through the punishment it threatens. (p. 88)

In order to understand Lessig's thoughts on code as a regulative force it is important to keep two things in mind: one is that Lessig takes a social constructivist position; the other is that his work needs to be understood against the background of the internet as a medium that leverages democracy. In Lessig's words the internet stood for "freedom without anarchy, control without government, [and] consensus without power" (p. 4).[12]

The initial technological structure of the internet was proposed by Tim Berners-Lee (1989). His goal was to create an information system that follows a network structure.

12 Schmidt (2000) calls this kind of "democracy promise" a constant variable in media development. He states that with every development of a new type of media the idea of more democracy is given new impetus. Therefore, this intial understanding may be rather hyperbolic (see discussion in Jensen, 2012)

Until then information was typically linear and hierarchically structured in book-type formats. Berners-Lee writes:[13]

> This is why a "web" of notes with links (like references) between them is far more useful than a fixed hierarchical system. When describing a complex system, many people resort to diagrams with circles and arrows. Circles and arrows leave one free to describe the interrelationships between things in a way that tables, for example, do not. The system we need is like a diagram of circles and arrows, where circles and arrows can stand for anything. (para. 10)

In conclusion Berners-Lee suggests:

> We should work toward a universal linked information system, in which generality and portability are more important than fancy graphics techniques and complex extra facilities. (para. 65)
>
> The aim would be to allow a place to be found for any information or reference which one felt was important, and a way of finding it afterwards. The result should be sufficiently attractive to use that the information contained would grow past a critical threshold, so that the usefulness the scheme would in turn encourage its increased use. (para. 66)

The notion of a new non-hierarchical hypertext structure generated the hope that technology could enable the long-desired idea of free information flows, accessible to everybody – namely the internet. Advocates of this new non-hierarchical communication network hoped that traditional information barriers could be overcome and therewith, a communication medium that serves democratic values could be established. As a disappointment to many, this hope has been overshadowed by capitalistic tendencies.

Through the examination of search engine technology, Introna and Nissenbaum showed that technical structures do not only raise technical issues but also political ones. This is because ranking functions operate on several criteria – some by design and some as an unintended consequences. Therefore, Introna and Nissenbaum (2000)

13 The original paper was assessed as "vague, but exciting" (http://info.cern.ch/Proposal.html, last access 14.08.2017).

conclude that “[information] [s]eekers are less likely to find less popular, smaller sites, including those that are not supported by knowledgeable professionals” (p. 175). Hence, the idea of information equality is not reflected in the technological structure as initially hoped. From a democratic perspective this is of concern, especially because market leaders might be able enforce values via technology. Sociologist Castells (2007) states:

> Throughout history communication and information have been fundamental sources of power and counter-power, of domination and social change. This is because the fundamental battle being fought in society is the battle over the minds of the people. The way people think determines the fate of norms and values on which societies are constructed.

As technological organizations such as Google or the producers of algorithmic media are highly influential with regards to information visibility, it has become highly relevant to understand the social implications of technological structure.

Mager’s (2012) article titled *Algorithmic ideology* argues for a shift of perspective away from examining the impact of technology on society, towards social practices and power relations feeding into the construction of technology. Hence, she takes modern capitalist society as the conceptual starting point and examines how capitalism shapes technological structure. Given the fact that technology is subject to commercialization tendencies this is especially relevant. Examining the history of search engines van Couvering (2008) noted that technology in the field of search engines has evolved from being entrepreneur-like technology created in academic environments into highly competitive refined products. While initial search technology was developed at universities, today’s services are produced by global organizations embedded in saturated markets. Search engines, as well as algorithmic media, compete in the field of information retrieval and management. Besides offering a valuable product they also pursue profit. In this field of tension, Gillespie (2014) highlights six dimensions of “public relevance algorithms that have political relevance” (p. 2):

1. Patterns of inclusion: the choices behind what makes it into an index in the first place, what is excluded, and how data is made algorithm ready

2. Cycles of anticipation: the implications of algorithm providers' attempts to thoroughly know and predict their users, and how the conclusions they draw can matter

3. The evaluation of relevance: the criteria by which algorithms determine what is relevant, how those criteria are obscured from us, and how they enact political choices about appropriate and legitimate knowledge

4. The promise of algorithmic objectivity: the way the technical character of the algorithm is positioned as an assurance of impartiality, and how that claim is maintained in the face of controversy

5. Entanglement with practice: how users reshape their practices to suit the algorithms they depend on, and how they can turn algorithms into terrains for political contest, sometimes even to interrogate the politics of the algorithm itself

6. The production of calculated publics: how the algorithmic presentation of publics back to themselves shape a public's sense of itself, and who is best positioned to benefit from that knowledge.

Gillespie's essay lacks empirical evidence, however, it does summarize comprehensively the issues around algorithms. Mostly technology is understood as something objective or neutral, especially the field of computer science which focusses primarily on the development of technology rather than the political implications of it. Technology is mostly understood and used as a "helping tool"; societal implications are merely reflections. This might explain why scientific reflections on algorithms are primarily critical inquiries. Because they raise awareness of political implications and show comprehensively how technology favours capitalistic values, however, but they do not elaborate further. The question is how can we deal with these issues? In-depth inquiries into the conceptualization of technology and the action possibility of users are especially lacking. Rieder (2009) states in relation to search engines:

> For this is the core of the problem: to "democratize search" we will have to incorporate a clear conceptual grasp of the technology, to reexamine our understanding of democracy, and to build bridges between these two on the levels of critique, design, and policy. (p. 17)

The same accounts for algorithms. In order to examine how information relevance arises and how it affects the democratic concept of an informed citizen, it is important to have a congruent framework to study algorithmic media. One framework that has been used previously is the institutional approach. Napoli (2013) summarizes:

> If we think, then of algorithms as institutions, the question then becomes, what kinds of effects are algorithmically-driven systems of media production and consumption having not only on other institutions, but on other aspects of civic and cultural life? In what specific ways is cultural production (that is, the actual content) being transformed by increased reliance on algorithmic systems for decision-making?

Under the institutional approach, a wider variety of questions are raised from the effects of algorithmic decision-making over social practices, norms and structures and about the institutionalization of algorithms – all aspects that have been discussed in the past three sections. Napoli describes institutional theory as a "very broad tent" (p. 4) from economical theories to political and social theories. As all those theories are based on different and partially opposing epistemological assumptions, I remain sceptical that an overall institutional approach is more valuable than individual studies in separate fields. However, more research in this area will show how fruitful the institutional approach is. Therefore, I will not go on to elaborate on the institutional approach, but will instead trace three influential functional approaches and reflect on their suitability in conceptualizing algorithmic media. I will start by looking at general systems theory, followed by the description of Shannon and Weaver's mathematical theory of communication and the theory of cybernetics. As a preliminary summary, I will discuss the the Input-Throughput-Output model of algorithmic selection proposed by Latzer et al. (2014).

## 3.2 Algorithmic media through the lens of functional systems theory

Having presented relevant literature relating to the study object algorithmic media, I now take the first step towards developing the conceptual framework of this research. In the following, I summarize established functional theories such as systems theory (see section 3.2.1), Shannon and Weaver's model of communication (see section 3.2.2) and cybernetics (see section 3.2.3), which have been highly influential in the theoretical description and advancement of technology. From systems theory originate the often used terms input, throughput and output. Shannon and Weaver's pioneering mathematical model of communication has provided insight into how communication can be transmitted electronically and additionally, the field of cybernetics has contributed with knowledge about regulative systems and their feedback processes. To summarize this section I will present and discuss the Input-Throughput-Output model of algorithmic selection on the internet (Latzer et al., 2014) as an example of how functional theories shape the current understanding of algorithmic processes.

### 3.2.1 General systems theory

Systems theory is based on a functional understanding of the world and can be understood as in opposition to the earlier mentioned social constructivist perspective. This is because systems theory is not concerned with the human creators of technology, in other words with the practitioners, but with how the individual technological elements operate together. Specifically, general systems theory evolved out of the necessity to grasp complex technologies, such as space and military vehicles, as a whole phenomena. Biologist Bertalanffy (1968), co-founder of the field of systems theory, observed that after World War II academic disciplines were strongly differentiated. He writes:

> Modern science is characterized by its ever-increasing specialization, necessitated by the enormous amount of data, the complexity of techniques and of theoretical structure within every field. Thus science is split into innumerable disciplines continually generating new subdisciplines. In consequence, the physicist, the biologist, the psychologist and the social scientist are, so to speak, encapsulated in their private universes, and it is difficult to get word from one cocoon to the others. (Bertalanffy 1968, p. 30)

Bertalanffy introduced general systems theory in order to offer a broad theoretical perspective that serves as a uniting framework for a variety of disciplines within the social as well as technical sciences. It was hoped that this framework would help overcome the fragmented academic landscape that existed at the time, with specializations in computer technology, cybernetics, automation and systems engineering. He further writes:

> Thus, there exist models, principles, and laws that apply to generalized systems or their subclasses, irrespective of their particular kind, the nature of their component elements, and the relations of "forces" between them. It seems legitimate to ask for a theory, not of systems of a more or less spacial kind, but of universal principles applying to systems in general.
>
> In this way we postulate a new discipline called *General System Theory*. Its subject matter is the formulation and derivation of those principles which are valid for "systems" in general. (emphasis in the original, Bertalanffy 1968, p. 32)

Bertalanffy's starting point was the observation that all fields of knowledge had to cope with increasing complexity (see also section 2.1). He uses the field of psychology as an illustrative example which back then used a basic stimulus-response model to explain human behavior. With the ongoing discoveries in the fields of biology, genetics and neuroscience, the demand for more complex models and frameworks arose. Prior to general systems theory, systems were studied through the analysis of their individual components. It was assumed that the functionality of systems could be explained through statements about the individual components. General systems theory, however, rejects this reductionist view by stating that complex systems produce emergent phenomena which cannot be fully explained through the analysis of individual components; but only through the study of the system as a whole. Bertalanffy further stated that biological systems can not be separated from their environment. Biological systems depend on their environment. Thus, if studied as systems, they need to be studied in relation to their environment – as open systems.

Overall, systems have been studied in two different manners: as open systems and as closed systems. Open systems are systems that stand in constant exchange processes with their environment. Most biological systems are studied this way. In contrast, closed systems are studied independently of their environment. Most physical systems are analyzed as closed systems. This means that they are described and investigated independently of their environmental forces. The advantage of studying systems in a closed manner allows the identification of all system variables. Thus, there are no unknown variables in the equation and various system states can be calculated accurately. The main difference between open and closed systems is how their final state is determined. The final state of a closed system is determined by the initial state of their elements. This means if initial conditions are changed or altered, the final state of the system will change as well.

Open systems, in opposition, follow the principal of "equifinality" (Bertalanffy 1968, p. 40). This means that the final system state does not solely depend on the initial conditions but can be produced in different ways. Bertalanffy therefore rejects linear assumptions and states that the final system state can not solely be predicted through the analysis of the initial conditions.

> [L]iving organisms are essentially open systems, i.e., systems exchanging matter with their environment. Conventional physics and physical chemistry deal with closed systems, and only in recent years has theory been expanded to include irreversible processes, open systems, and states of disequilibrium. If, however, we want to apply the model of open systems to, say, the phenomena of animal

> growth, we automatically come to a generalization of theory referring not to physical but to biological units. (Bertalanffy 1968, p. 32)

The open systems approach started with observations in biology and as already described its aim was to extract universal principles that describe and allow the analysis of empirical phenomena in all its complexity. Bertalanffy (1968) outlines the theory as follows: "In this way we postulate a new discipline called General System Theory. Its subject matter is the formulation and derivation of those principles which are valid for "systems in general" (p. 32). It can be stated that essentially systems theory is an approach to grasp systems in their wholeness. It evolved in opposition to reductionist tendencies in the analysis of systems. Further, the term "general" refers to the study of phenomena on a comprehensive basis rather than in isolation. The underlying assumption of general systems theory is that laws exist that can be applied to any kind of system within any given field.

According to Bertalanffy (1968) systems are generally defined as "sets of elements standing in interaction" (p. 38). As this is a rather vague definition Bertalanffy suggests a mathematical approach that specifies these elements with the help of differential equations. In addition to the mathematical description of systems Bertalanffy notes that in contrast to physics which revolves around energy, and economics which revolves around financial resources, the field of communication is essentially concerned with the flow of information. General systems theory is thereby closely connected to the mathematical theory of information introduced by Shannon and Weaver on which I will elaborate in the next section.

In order to understand and conceptualize algorithmic media, which is the goal of this chapter, it is important to understand the historical roots of mechanical engineering. Therefore I am presenting here historical texts which have been highly influential on current understandings. Algorithms as computer technology in social science research are currently conceptualized as black-box technologies through which communication flows rather ambiguously. Influencing factors are for the most part unknown. The previous discussion on open and closed systems shows the importance of the framework algorithmic media is studied in. If algorithmic media is studied in a closed systems context, all systems variables can be extracted but contextual influences are lacking. In an open systems perspective, on the other hand, the complexity of the phenomenon can be taken into account, but individual factors may be disregarded.

### 3.2.2 Shannon and Weaver's mathematical theory of communication

A precursor of modern communication theory is Shannon and Weaver's mathematical theory of communication. This mathematical model has been discussed extensively within communication science, however, to understand the conceptual framework presented in this research it is helpful to excavate the roots of contemporary communication models. Shannon and Weaver's (1949) model is based on findings of the telegraph transmission theory. The initial problem statement reads as follows:

> The fundamental problem of communication is that of reproducing at one point either exactly or approximately a message selected at another point. Frequently the messages have *meaning*; that is they refer to or are correlated according to some system with certain physical or conceptual entities. These semantic aspects of communication are irrelevant to the engineering problem. The significant aspect is that the actual message is one *selected from a set* of possible messages. The system must be designed to operate for each possible selection, not just the one which will actually be chosen since this is unknown at the time of design. (emphasis in the original, p. 3)

This initial statement shows that Shannon and Weaver seek to design a communication system that is able to transport a selected message. The semantic aspect of the message is, as stated in the quote above, irrelevant. What is important is that the message selected at one point can be equally reproduced at another point. At that time, the idea of electronically transporting communication was quite novel and is from my perspective one of the main contributions in the field of communication. The notion of communication changed from being something that arises at a certain point towards something that electronically travels and is being reproduced. The communication system that Shannon and Weaver theoretically designed includes the following five parts: (1) an information source, (2) a transmitter, (3) a channel, (4) a receiver and (5) a destination (see figure 6).

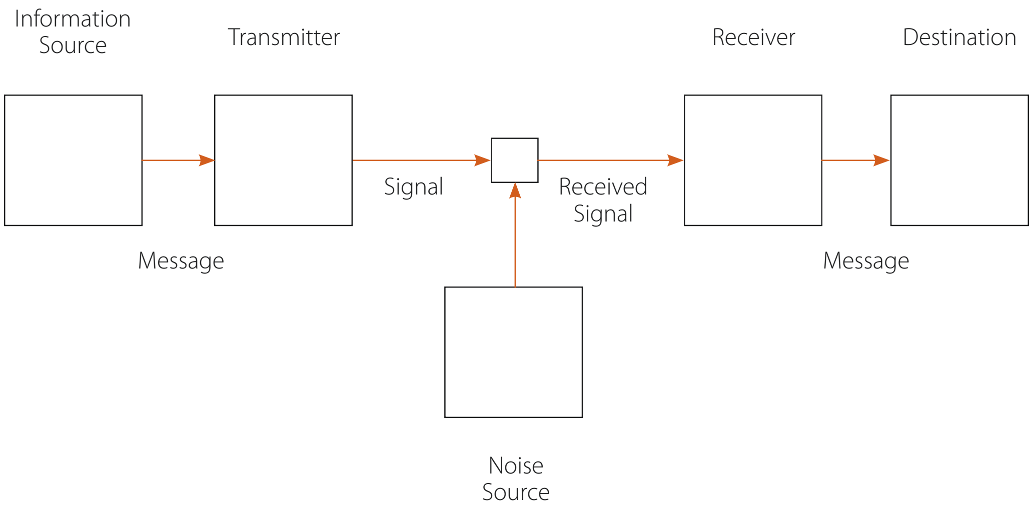



Figure 6: Schematic diagram of a general communication system (cf. Shannon and Weaver, 1949)

Shannon and Weaver write that the information source (1), which can be seen in the figure on the far left, "produces a message or sequence of messages to be communicated to the receiving terminal" (p. 4). The message can take on various forms such as a letter or a telegraph, a radio signal or a TV signal. The transmitter's function (2) is to convert the message into a signal that can be transmitted. The signal is then passed through the channel (3), which "may be a pair of wires, a coaxial cable, a band of radio frequencies, a beam of light, etc." (p. 5). While the signal is transmitted it might be disrupted by noise, which has an influence on what is transmitted. The receiver (4) then converts the signal back into the message, which is received at the destination (5): "the person (or thing) for whom the message is intended" (p. 6). Within this model the term communication is used broadly to describe "all of the procedures by which one mind may affect another" (p. 95). Further, they write:

> This, of course, involves not only written and oral speech, but also music, the pictorial arts, the theatre, the ballet, and in fact all human behavior. In some connections it may be desirable to use a still broader definition of communication, namely, one which would include the procedures by means of which one mechanism (say automatic equipment to track an airplane and to compute its probable future positions) affects another mechanism (say a guided missile chasing this airplane). (p. 95)

Shannon and Weaver approach communication from a technical angle. As argued earlier Balnaves and Willson (2011) therefore noted that it was with Shannon and Weaver that the idea of information as quantity began to take shape. This is also due to the notion that Shannon and Weaver had specified three levels of communication problems: (A) the technical level, (B) the semantic level and (C) the level of effectiveness. Within (A) they asked how accurately the symbols of communication can be transmitted. (B) is concerned with the question of how precisely the transmitted symbols convey the desired meaning and (C) looks into how effectively the received meaning is understood as intended. Even though Shannon and Weaver's theory is primarily concerned with (A), they also explore possibilities to apply their theory on level (B) and (C). In this regard they write: "One can imagine, as an addition to the diagram, another box labeled "Semantic Receiver" interposed between the engineering receiver (which changes signals to messages) and the destination" (p. 115). Later communication theories focus often on the level of effectiveness. In particular, within management studies communication has been described as successful when the "message" has been "transmitted effectively". Shannon and Weaver give in this regard the example of a girl accepting a telegram.

> An engineering communication theory is just like a very proper and discreet girl accepting your telegram. She pays no attention to the meaning, whether it be sad, or joyous, or embarrassing. But she must be prepared to deal with all that come to her desk. This idea that a communication system ought to try to deal with all possible messages, and that the intelligent way to try is to base design on the statistical character of the source, is surely not without significance for communication in general. Language must be designed (or developed) with a view to the totality of things that man may with to say; but not being able to accomplish everything, it too should do as well as possible as often a possible. That is to say, it too should deal with its task statistically. (p.115)

This citation sums up very clearly the view on communication in Shannon and Weaver's communication theory. Communication takes places within a system clearly defined by a sender and a receiver. The message is transmitted electronically; the meaning of the message plays a minor role.

The examination of Shannon and Weaver's theory is interesting insofar as it sheds light on the roots of the mathematical perspective on communication. In this perspective communication is first and foremost "matter" that needs to be transmitted over a certain distance. On the internet this means a message that someone writes at a certain point is transmitted to another point. Hence, software engineers are concerned with the task of transmitting messages – the meaning or the impact of the message is of less concern. This also sheds light on the different perspectives on algorithms. While from a engineering perspective the undisturbed information flow is most important, from a social perspective it is the content that matters. These two different perspectives often meet and lead to misunderstandings. Engineers or programmers might not agree on being held accountable for the content of messages, however, socially they are often deemed responsible. Discussions in this regard are lead under the term 'algorithmic accountability'. The question being raised is: can algorithms and their creators be held responsible for the content of messages they are transmitting? The examination of Shannon and Weaver's theory already suggests that algorithmic media cannot solely be explained through its technological structure. Before I discuss this in further detail, I want to shed light on the idea of feedback mechanisms brought forth by theorists in the field of cybernetics.

### 3.2.3 Cybernetics

In the last section I described Shannon and Weaver's electrical engineering approach to communication. According to their theory, communication takes place in a system consisting of several units, among them a sender and a receiver. A key area of concern in this engineer-driven perspective is the accurate and complete transmission of messages. Less attention is paid to the content and context of the message. Cybernetics, which draws on Shannon and Weaver's mathematical model and originates from the same time period, is concerned with "the study of messages as a means of controlling machinery and society" (Wiener, 1988, p. 15). The term is derived from the Greek word kubernētēs, which means "steersman". Hence, cybernetics is concerned with how communication can be utilized to steer machines or social systems through feedback. Norbert Wiener (1961), one of the founders of the field, notes in the preface of his second edition on cybernetics:

> When I first wrote *Cybernetics*, the chief obstacles which I found in making my point were novel and perhaps even shocking to the established attitudes of the time. At present, they have become so familiar as a tool of the communication engineers and of the designers of automatic controls that the chief danger against which I must guard is that the book may seem trite and commonplace. The role of feedback both in engineering design and in biology has come to be well established. (emphasis in the original, Wiener, 1961, p. vii)

A more common and slightly alleviated word for feedback used today is governance. The posed question would then be how specifically technical systems can be governed via communication. Thus, cybernetics pays more attention to the content of the message. Wiener elaborates as follows:

> In giving the definition of Cybernetics in the original book, I classed communication and control together. Why did I do this? When I communicate with another person, I impart a message to him, and when he communicates back with me he returns a related message which contains information primarily accessible to him and not to me. When I control the actions of another person, I communicate a message to him, and although this message is in the imperative mood, the technique of communication does not differ from that of a message of fact. Furthermore, if my control is to be effective I must take cognizance of any messages from him which may indicate that the order is understood and has been obeyed. (Wiener, 1961, p. 16)

As shown in the citation Wiener introduces the element of control in relation to communication systems. In this sense control is a regulating element; an element that can be manipulated to regulate the system. Therewith, the description of systems has been expanded from the mere process of the transmission of messages to the content and likewise objective of the message. In particular, cybernetics revolves around accomplishing a set objective when transmitting a message. Is this perspective communication is functional and goal-oriented; and thereby holds a distinctive role. With the idea that communication generally or more messages more specifically can be used as an element to steer machines, Wiener expands the idea of what a communication system is and what it can accomplish. Specifically, Wiener is concerned with the question of how orders can be communicated within machines. The starting point for the exploration of this question is human communication. Wiener states that

> when I give an order to a machine, the situation is not essentially different from that which arises when I give an order to a person. In other words, as far as my consciousness goes I am aware of the order that has gone out and of the signal of compliance that has come back. To me, personally, the fact that the signal in its intermediate stages has gone through a machine rather than through a person is irrelevant and does not in any case greatly change my relation to the signal. Thus the theory of control in engineering, whether human or animal or mechanical, is a chapter in the theory of messages. (Wiener, 1961, p. 16)

Interestingly, Wiener and many fellow scientists of his time do not distinguish between man and machine. Both are described as functional systems, humans as well as computers being described using system language. The citation above reiterates a shift of focus from the transmission of communication towards the message itself and how it is received. In this regard, Wiener introduces the notion of feedback with the example of biological systems. He does so by describing two patients which are treated in a neurological hospital. Both patients suffer from a form of ataxia. That means both patients can not control their movements. One patient suffers from distinctive unpredictable movements while walking. The other from similar unpredictable movements while grabbing things with his arms. Both patients lack the ability of fine motor skills. Wiener explains the reason for their condition as follows:

> The incoming messages are blunted, if they have not totally disappeared. The receptors in the joints and tendons and muscles and the soles of his feet, which ordinarily convey to him the position and state of motion of his legs, send no messages which his central nervous system can pick up and transmit, and for information concerning his posture he is obliged to trust to his eyes and the balancing organs of his inner ear. (...)
>
> We thus see that for effective action on the outer world it is not only essential that we possess good effectors, but that the performance of these effectors be properly monitored back to the central nervous system, and that the readings of these monitors be properly combined with the other information coming in from the sense organs to produce a properly proportioned output to the effectors. (Wiener, 1961, p. 96)

In addition to Shannon and Weaver, Wiener introduces feedback within the system. The often cited example of a self-regulating thermostat sheds light on automatic feedback systems.

> There is a setting for the desired room temperature; and if the actual temperature of the house is below this, an apparatus is actuated which opens the damper, or increases the flow of fuel oil, and brings the temperature of the house up to the desired level. If, on the other hand, the temperature of the house exceeds the desired level, the dampers are turned off or the flow of fuel oil is slackened or interrupted. In this way the temperature of the house is kept approximately at a steady level. Note that the constancy of this level depends on the good

> design of the thermostat, and that a badly designed thermostat may send the temperature of the house into violent oscillations not unlike the motions of the man suffering from cerebellar tremor.

The example of the thermostat shows how Wiener describes feedback. Feedback does not occur contextually but according to a given input variable. Hence, a temperature is set and according to this set temperature the room is climatized. This idea can be linked back to the general description of open and closed systems (see section 3.2). The examples Wiener uses are described in accordance to closed systems, meaning that the environment is not considered.[14]

Another important theorist in relation to cybernetics, the notion of complexity and system theory is Heinz von Foerster. He is especially well known for his idea of second-order cybernetics, which is based on two premises. He calls the first premise "Humberto Maturana's Theorem Number One" and the second premise "Heinz von Foerster's Corollary Number One". Maturana's theorem states that "*Anything said is said by an observer*", von Foerster's corollary states "*Anything said is said to an observer*" (emphasis in the original, von Foerster 2003, p. 283). With these two premises von Foerster establishes three primary theoretical concepts: (1) the observer, (2) the language and (3) the society. Society is formed through at least two observers using the same language. He continues:

> They are: first, the observers; second, the language they use; and third, the society they form by the use of their language. This interrelationship can be compared, perhaps, with the interrelationship between the chicken, and the egg, and the rooster. You cannot say who was first and you cannot say who was last. You need all three in order to have all three. (von Foerster 2003, p. 283)

Von Foerster states that the observer does not exist independently or in a neutral form but also possesses properties, therefore he introduces second-order cybernetics. Sec-

14 Wieners ideas have especially been incorporated in the present field of strategic communication, where communication is utilized for a specific purpose. The main concern of the field is how communication can be utilized to archive a specific goal.

ond-order cybernetics acknowledges the entanglement between the observed and the observer. While first-order cybernetics is concerned with breaking a system down into its components and visualizing them as something simple and mostly linear, second order cybernetics approaches systems as circular observing systems. This means the observing system also needs to be investigated, and the idea of an objective or neutral observer is revised. Every observation takes place through the characteristics of the observing system. Transferred to society, von Foerster notes:

> From this it appears to be clear that social cybernetics must be a second-order cybernetics – a *cybernetics of cybernetics* – in order that the observer who enters the system shall be allowed to stipulate his own purpose: he is autonomous. If we fail to do so somebody else will determine a purpose for us. Moreover, if we fail to do so, we shall provide the excuses for those who want to transfer the responsibility for their own actions to somebody else: "I am not responsible for my actions; I just obey orders." Finally, if we fail to recognize autonomy of each, we may turn into a society that attempts to honor commitments and forgets about its responsibilities. (von Foerster 2003, p. 286)

In summary, cybernetics is mostly concerned with the notion of feedback in regulatory systems. Systems are regulated through a special apparatus that initiates change within the system. In the earlier given example of a heating system it is the thermostat, which can be manipulated in order to provoke system change. This close connection between the regulatory mechanism and the system itself is called circular feedback.

### 3.2.4 Preliminary summary: The Input-Throughput-Output model of algorithmic selection

After tracing the origins of general system theory – Shannon and Weaver's mathematical model of communication and cybernetics – I will now show how these theories play out when applied to algorithms. To my knowledge, the only study that explicitly inquires into the actual functionality of algorithms is a working paper published online by Latzer et. al (2014) from the University of Zurich (see figure 7). In this working paper, algorithmic procedures are summarized under the term "algorithmic selection" and summarized as follows:

> Algorithmic selection is embedded in a variety of Internet-based services and is applied for numerous purposes. Although their modes of operation differ in detail, all of these applications are characterized by a common basic functionality: They automatically *select* information elements and *assign relevance* to them. (emphasis in the original, Latzer et. al 2014, p. 1)

In the working paper, algorithms are defined as "a finite series of precisely described rules or processes to solve a problem" (p. 4). The proposed model by Latzer et al. divides the process of algorithmic selection into three stages; the input, the throughput and the output. The throughput stage lies at the center of the model and this is where algorithms perform a variety of statistical calculations that define the output. The data that is processed in the throughput stage is derived from the input stage, where the data collection takes place. From the collected data set a certain number of items is selected. "Accordingly", so the authors write, "algorithmic selection on the Internet is defined as a process that assigns relevance to information elements of a data set by an automated, statistical assessment of decentrally generated data signals" (p. 5). It is further stated that input and output data may vary depending on the application and the availability of data.

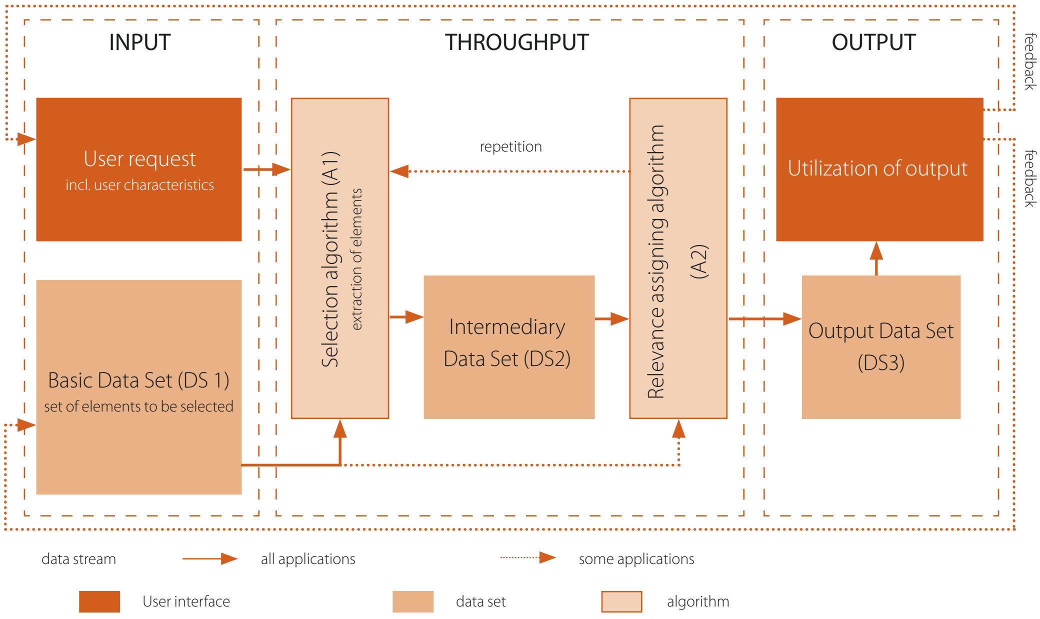



Figure 7: Input-Throughput-Output model of algorithmic selection on the internet (cf. Latzer et. al, 2014, p. 4)

Due to the nature of the working paper the description of the model is rather vague. It remains unclear how exactly the process of assigning relevance takes place and how individual items are selected. Although Latzer et al. do not go further into the theoretical fundamentals of their model, similarities to systems theory and cybernetics can be observed through the employed terminology of input, throughput and output and the notion of feedback. Therefore, it can be assumed that systems theory and cybernetics serves as a basis for Latzer et al.'s model and hence, I will be using this model to demonstrate how functional theories in their broadest sense have influenced current ideas of algorithmic processes.

As mentioned above systems theory examines the individual components of a system and makes statements about the general principals of the system based on the analysis of its parts. As explained, there are two major fields in systems theory; the study of systems in an open, and in a closed manner. Open systems, such as biological systems, are studied in relation to their environment, and closed systems, such as physical systems, are studied independently of their environment. In general, systems theory builds on the assumption that systems, no matter if open or closed, can be broken down into their individual components and that those can be studied independently. However, system theory also notes that the study of the individual components may not necessarily lead to concluding knowledge about the system, because every system holds the possibility of emergent phenomena. That means that the system outcome may not solely be attributed to the functionality of the individual parts of the system.

Latzer et al. break the system of algorithmic selection down into the three elements of input, throughput and output. In the input stage data is fed into the system. The data that is algorithmically selected becomes then visible in the output stage. The process of algorithmic selection takes place in the throughput stage. The input and the output stage are connected through feedback mechanisms. As stated above, the notion of feedback was first introduced in cybernetic theory. Feedback serves as a mechanism to regulate systems. An often-mentioned simple example of regulated systems is the heating thermostat where the thermostat is used to regulate the room temperature. Within the presented Input-Throughput-Output model the given feedback is divided into the data set and the user request. Both types of feedback influence the system of algorithmic selection. Likewise, the system of algorithmic selection is divided into the algorithm and the data set. Further, algorithmic processes in the throughput stage are divided into a selection algorithm and a relevance assigning algorithm. Both algorithms, the selection algorithm as well as the relevance assigning algorithm, are repeatedly executed. Thus, the processed data set passes several algorithmic calculations before being displayed as output data. The utilization of the output data depends on the application itself. In addition to the presented functional model, Latzer et. al offer a typology of algorithmic selection applications which I will shortly summarize. The typology categorizes algorithmic selection services into (1) search applications, (2) aggregation applications, (3) observation/surveillance applications, (4) prognosis/forecast applications, (5) filtering applications, (6) recommendation applications,

(7) scoring applications, (8) content production applications and (9) allocation applications (Latzer et. al, 2014, p. 6).

The first type, search applications, are commonly known services such as Google or Bing. They are significant services because they are the main entry points to the internet. The search practice is one of the most common internet practices today. The second type, aggregation applications, are news aggregators that "collect, categorize and regroup information from multiple sources into one single point of access" (Latzer et. al, 2014, p. 6). The sixth type, recommendation applications such as Amazon or Spotify are similar to aggregation applications. The third type, observation and surveillance applications, are lesser known. Mostly, these services are used to analyze online behavior and to predict risks. The governmental use of these services has been critized heavily, especially in the light of the Snowden case (Greenwald, 2014). Prognosis and forecast services, the forth type, are mostly applied in the field of entertainment and gaming. Here algorithms are used to predict behavior. The fifth type, filtering applications, are rarely used alone and therefore are mostly part of other applications. E-mails, for example, can be filtered by using simple algorithms. One of the main purposes of scoring applications (7) is to build trust. They are mostly used to retrieve ratings. Content production applications (8) use algorithms to produce text, music and similar content. Their rise has been publicly debated, journalists are especially critical of content production applications in the field of news. The last type, allocation applications, are algorithmic services that manage transaction and resources, such as Google's AdSense. This brief summary of the different algorithmic services shows how widespread the use of algorithms is and how manifold their applications are. The proposed model of algorithmic selection by Latzer et al. offers insight into the different components of the system, however, it makes no claims about the specific principals of each component. In the working paper algorithms have been defined as rule-driven and problem-solving, however, the exact rules have not been specified. Here the analysis of specific programming code may be helpful and may lead to further insights. However, due to the fast changing nature of algorithmic services, I suggest another approach. I instead argue for a conceptualization of algorithmic media from a communication perspective. This is helpful insofar as it shed lights on the communicative dynamics governing algorithmic services instead of their functional mechanics. Rather than defining algorithmic services through their technological operation mode I aim at shifting perspective towards algorithm-user-communication. With a shift of focus from algorithmic functionality towards the algorithm-user relationship I aim to contribute towards an understanding of algorithmic media that includes the user behavior as a decisive element as proposed in chapter 2.

### 3.3 Developing a communicative approach towards algorithmic media

After presenting and discussing functional frameworks towards studying algorithms, I will now introduce a communication perspective on algorithmic media. As stated in the introduction to this chapter the concept of the communicative other introduced by Gunkel (2012) is a valuable approach towards overcoming socio-technical distinctions. Instead of focussing on either algorithmic functionality or social usage, it sheds light on their communicative relationship. The communicative perspective on algorithmic media draws on Gunkel's concept as well as the communication-as-constitute approach (abbreviated as CCO; Ashcraft, Kuhn and Cooren 2009, Schoeneborn 2008). The CCO approach reverses functional systems theory by stating that communicative processes constitute systems. This CCO view contrasts with currently dominating approaches when studying digital technology. In conclusion to this chapter, after presenting and reflecting on Gunkel's concept and the CCO approach, I present the final conceptual framework on algorithmic media which frames the empirical inquiry.

### 3.3.1 The communicative other


Figure 8: Peter Steiner's cartoon, as published in The New Yorker, July 5, 1993 [15]

Gunkel's (2012) essay *Communication and AI* advocates for a paradigm shift from computer-mediated communication (abbreviated as CMC) towards understanding computers as communicative others. So far, the dominating view on computers is through an engineering lens; mostly computers are conceptualized as tools for transmitting communication. Gunkel's call for a paradigm shift is based on the observation that in the digital realm computers increasingly communicate with other computers. Hence, so Gunkel argues, current models of digital technology must be critically scrutinized. Using the famous Peter Steiner cartoon as an example (see figure 8), he writes:

> What the cartoon illustrates is not only the anonymity and indeterminacy of others in CMC but also the unquestioned assumption that despite this anonymity, users assume that the other with whom they interact and communicate is another human being. The other who confronts us is always, it is assumed, another human person, like ourselves. (Gunkel, 2012, p. 1)

Advancements in digital applications, such as text and speech recognition, put the assumption that computer technology enables communication between two human users under critical scrutiny. Gunkel writes: "The computer, therefore, substantively re-

15 Downloaded from: https://en.wikipedia.org/wiki/On_the_Internet,_nobody_knows_you're_a_dog#/media/File:Internet_dog.jpg (last access 22.7.2017)

sists being exclusively defined as a medium and instrument through which human users exchange messages. Instead, it actively participates in communicative exchanges as a kind of additional agent and/or (inter)active co-conspirator" (p. 19). In conclusion, Gunkel proposes to understand the computer as a communicative other "who confronts human users, calls to them, and requires an appropriate response" (p. 21). To my knowledge of the field this is a provoking and simultaneously comprehensible conclusion.

Gunkel derives his concept of the communicative other through a reflection on Turing's famous essay "Computer Machinery and Intelligence" first published in Mind (Turing, 1950) and Licklider and Taylor's essay *The Computer as Communications Device* first published in Science and Technology (Licklider and Taylor, 1968). Mathematician and computer scientist Alan Turing is said to be one of the most influential thinkers in the field of algorithms and artificial intelligence. In his essay "Computer Machinery and Intelligence" Turing deals with the question of when a machine can be referred to as intelligent. Until then, only humans were considered to be intelligent, and for the majority of people the idea of intelligent machines was beyond their imagination. Machines could perform mechanical tasks such as calculations but they were not designed to make intelligent decisions.

Turing, however, turned the distinguished computer science question *Can machines think?* into a thought experiment, which he called the "Imitation game". The main question of the game was when machines can be considered intelligent. In order to answer this question he first inquired into human intelligence, setting up a room with a man (A), a woman (B) and an interrogator (C). The interrogator (C) is located in a separate room (see figure 9). The interrogator's task is to identify who is the man and who is the woman in the other room. According to psychological theory at that time being able to do so indicates intelligence. Hence, Turing reasons how a person would do and concludes they would ask questions in order to determine the gender of the others.

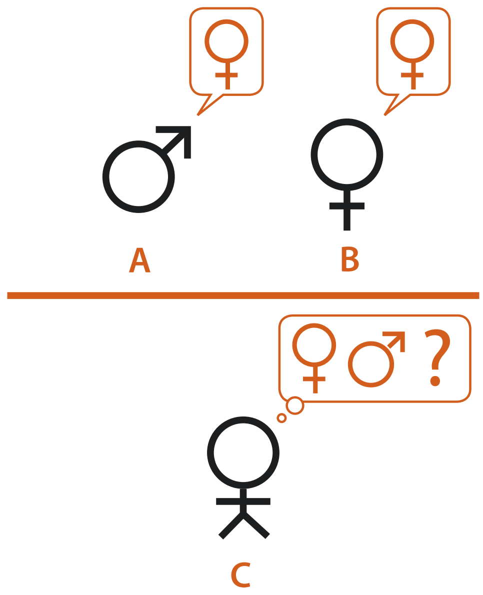



Figure 9: The Imitation Game, phase One (cf. Gunkel, 2012, p. 3)[16]

Since the interrogation is taking place in separate rooms questions are asked via written communication. The game would start by the interrogator (C) asking typical questions such as "How long is your hair?" in order to collection information about A and B. This is nothing particularly spectacular. However, what makes this thought experiment pioneering is the introduction of the question: "What will happen when a machine takes the part of A in this game?" (Turing, 1950, para. 1). Will the interrogator at all be able to determine that in the other room is neither, a woman nor a man? The overall question is at what point does computer technology become so convincing that it appears human. The answer to this question is when the computer can *communicate* humanly. Back then, being able to communicate was considered an essentially human quality. When inventing the thought experiment in 1950, Turing predicts:

> I believe that in about fifty years' time it will be possible, to programme computers, with a storage capacity of about 109 [bits], to make them play the imitation game so well that an average interrogator will not have more than 70 per cent chance of making the right identification after five minutes of questioning. (Turing, 1950, para. 6)

16 Downloaded from: http://en.wikipedia.org/wiki/Turing_test (last access 2.07.2017)

While Turing predicted intelligent computers for the year 2000 at the earliest, just 16 years later, in 1966, computer scientist Joseph Weizenbaum introduced a computer software called ELIZA that was able to create the illusion of being human and thereby prove Turing's theory. ELIZA is a psychological application based on the Rogerian principle of psychotherapy. Reporting on ELIZA Weizenbaum (1966) writes:

> With ELIZA as the basic vehicle, experiments may be set up in which the subjects find it credible to believe that the responses which appear on his typewriter are generated by a human sitting at a similar instrument in another room. (Weizenbaum, 1966, p. 42)

This is how a typical conversation with ELIZA may look like[17]:

ELIZA: Is something troubling you ?

YOU: Maybe

ELIZA: You aren't sure ?

YOU: I am not certain

ELIZA: How long have you been not certain ?

YOU: For quite some time

ELIZA: Does talking about this bother you ?

YOU: Not really

ELIZA: That is interesting. Please continue.

YOU: I do not know what to say

ELIZA: Can you elaborate on that ?

YOU: Not really

ELIZA: What does that suggest to you ?

YOU: Nothing

ELIZA: That is interesting. Please continue.

17 ELIZA can be tested on various websites, this "conversation" is taken from: www.masswerk.at/elizabot (last access 22.07.2017)

The main mechanism behind ELIZA rephrases statements into questions to help the person to gain more insight into themselves. Both Turing and Weizenbaum's inventions point towards the idea of computers being more than mere mechanical machines. It is in the process of communication where their actual potential unfolds. On this idea Licklider and Taylor (1968) begin their essay:

> In a few years, men will be able to communicate more effectively through a machine than face to face. (p. 21)

What exactly they refer to in this context remains unclear. However, this statement is followed by the prediction that the interaction with a machine will change the process of communication, which is more than true today:

> We believe that communicators have to do something nontrivial with the information they send and receive. And we believe that we are entering a technological age in which we will be able to interact with the richness of living information – not merely in the passive way that we have become accustomed to using books and libraries, but as active participants in an ongoing process, bringing something to it through our interaction with it, and not simply receiving something from it by our connection to it. (p. 21)

Licklider and Taylor agree that from an engineering perspective communication is understood as a process of transmission. This means in engineering terms communication must be transmitted from one point to another via code and signals. However, in the human process of communication what Licklider and Taylor call a "creative moment" occurs: "When minds interact, new ideas emerge" (p. 21). Hence, it is important to distinguish between the different processes of communication. From an engineering perspective communication signified something different than from a human perspective. An interesting question now is how digital technology relates to communicative processes. Licklider and Taylor assume that:

> Its presence can change the nature and value of communication even more profoundly than did the printing press and the picture tube, for, as we shall show,

> a well-programmed computer can provide direct access both to informational resources and to the processes for making use of the resources, *(sic!)*. (p. 21)

Licklider and Taylor's essay as well as Turing's thought experiment highlight that the computer has a variety of applications reaching beyond straightforward calculation processes. Even though computational devices have initially been designed to process mathematical operations, they have now transformed into machines that can be communicated with. That in turn also means that machine processes and machine languages have become more advanced. Highly complex and versatile knowledge is a prerequisite to turn computers into communicators. Licklider and Taylor eventually assess digital technology as follows:

> When people do their informational work "at the console" and "through the network," telecommunication will be as natural an extension of individual work as face-to-face communication is now. The impact of that fact, and of the marked facilitation of the communicative process, will be very great—both on the individual and on society. (p. 40)

As of today, the prediction that computers will facilitate communicative processes has definitely proven true. Several digital applications enable and facilitate communication. Do they then also communicate with the user as Gunkel suggest? Do they confront the user and call them to action? Considering current storage capacities and digital applications, it is true that an average user can no longer identify if written communication has come from a machine or a human. Artificial text generators have become so efficient that they autonomously report on sports games and analyze large data sets. Hence, to view computers and digital applications as communicative others is a helpful conceptual lens to further our understanding of artificial computational processes. To view computers and digital applications as mechanical transmitters of communication is to overlook the specific attributes of artificial intelligence as preconceived and invented by computer science pioneers.

Lessig stated that "code is law" and the earlier mentioned concept of affordances emphasizes once again the behavioral implications digital technology entails. While this may be comprehensible when looking at specific applications, how can algorithmic performance be taken into account? Algorithms materialize in digital applications but they can not be observed per se. Here the CCO approach seems a valuable way to shed light on communicative relations. Instead of conceptualizing the digital phenomenon of algorithmic media as a tool it seems helpful to think of it as a communicative process between algorithms and their users.

### 3.3.2 The CCO approach

The CCO perspective follows the basic idea that organizational systems are first and foremost communicative phenomena; initiated and sustained through and by communicative practices (Schoeneborn et al., 2014). The CCO approach takes a unique communications perspective on organizations and offers the possibility of linking organizational studies with communication studies. Instead of conceptualizing organizations as structural formations or systems, the CCO approach identifies communicative relationships as decisive within systems; in other words they constitute systems. Hence, communication is not exclusively seen as a tool for expression but as means through which reality is created (Ashkraft, Kuhn and Cooren, 2009). According to a panel discussion documented in Management Communication Quarterly (Schoeneborn et al., 2014) three schools of thinking can be identified in the current CCO field: (1) the Montreal School of Organizational Communication, (2) the Four-Flows Model, which is based on Gidden's theory of structuration, and (3) Luhmann's theory of social systems. According to Schoeneborn et al. it is the notion of communication as a constitutive element that unites the three distinguished schools of thinking, though their epistemological, ontological, and methodological underpinnings differ.

The Montreal School, established by Canadian scholar James Taylor and french sociologist François Cooren, sets a relational start point for analytical inquiries stating that: "Investigating something – whether that is human interaction, atomic particles, or biological organisms – consists of engaging with or getting in contact with objects, *which act on us as much as we act on them*" (citation of Coreen in Schoeneborn et al. 2014, p. 288, emphasis in the original). Coreen's and Taylor's relational way of thinking relates closely to Actor Network Theory proposed by Latour (2005), who declares:

> (...) to explain is not a mysterious cognitive feat, but a very practical world-building enterprise that consists in connecting entities with other entities, that is, in tracing a network. So, ANT cannot share the philosophy of causality used in social sciences. Every time some A is said to be related to some B, it's the social itself that is being generated. (p. 103)

This citation emphasizes and reflects on the relational way of thinking and links it to the concept of interconnectedness. It is assumed that different objects are related per se, as they are all part of a network. This notion is especially true for the digital realm, which is based on a hyperlink structure. The click itself is what connects users and objects, and not time and space which creates a social room outside the digital realm. The network structure is fundamental and decisive of the digital realm.

In one of their first articles Cooren and Taylor (1997) inquire into the organizing nature of communication, investigating how language forms organizations. Examining speech act theory the authors present communication "as an activity of mediation which consists of illocutionarily distributing and perlocutorily fixing enablements and constraints which form the basis of all organizational structure" (p. 219). Practically speaking this means that words such as "innovation" or "management" enact organizing principles and therefore organizations need to carefully determine corporate language. While the finding might seem common sense nowadays, Taylor and Coreen's writings have been one of the first to point out this organizing principle of communication in the field of organizational studies.

The second school of thinking is represented by McPhee and Zaug (2000), who introduced the four flows model (see figure 10).

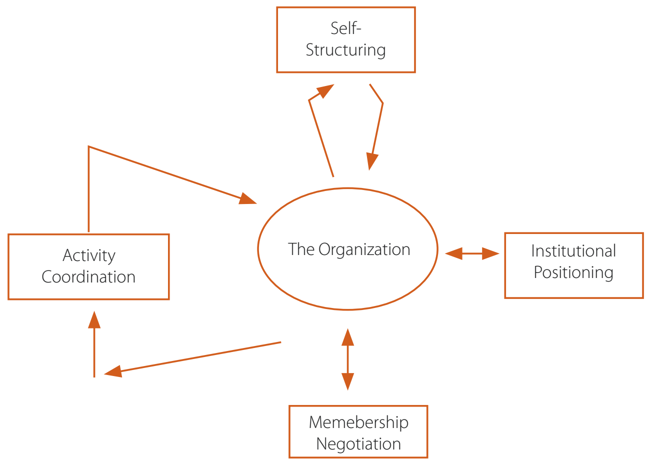



Figure 10: The four flows model (cf. Mc Phee and Zaug, 2000, para. 22)[18]

The four flows model is based on three epistemological principles (Schoeneborn et al. 2014, p. 288). The first principle states that knowledge needs to be defined prior to its acquisition. The second principle sets forth that the production of knowledge is highly institutionalized and the third principle points toward the knowledge of agents:

> People, as capable agents, have practical knowledge of their surroundings that is certified by the fact that it works, and such knowledge is the basis for the emergence of other knowledge and of interpretive resources as well as the communication flows that constitute organization. (citation of McPhee in Schoeneborn et al. 2014, p. 289)

While studying how communication constitutes organizations, McPhee and Zaug found that four distinctive communication flows contribute towards organizational constitution. The four flows differ in their direction and nature of contribution. Through each flow social structure is generated and eventually communication and organization become indistinguishable. The first communication flow, membership negotiation, relates to the process of creating relationships with organizational members.

18 The illustrations of the model vary slightly. This figure is taken out the first text McPhee and Zaug published in 2000.

Membership relations are vital to organizations and communication is essential in the process of maintaining long-term memberships. According to McPhee and Zaug it is the second communication flow – self-structuring – that distinguishes organizations from looser social groups. An organization does not naturally come into being or function by itself; a valuable amount of time and effort needs to be invested until an organization is able to maintain its general functions. Hence, the communication flow of self-structuring refers to the reflexive processes of designing and controlling which are also subject to power relations.

> It is important to emphasize that self-structuring is a communication process among organizational role-holders and groups; it is analytically distinct from, though often part of the same messages as, communication that helps coordinate the activities of members. It is unique in that it does not directly concern work, but rather the internal relations, norms, and social entities that are the skeleton for connection, flexing, and shaping of work processes. (para. 28)

This citation emphasizes the constitutive role of communication. Memberships and internal relations need to be constantly communicatively negotiated and this is typically an enduring process. The third communication flow called activity coordination is closely related to the process of self-structuring and points towards the goal-oriented nature of organizations. Organizations are typically built to serve a specific purpose or distinct values, allowing processes and day-to-day problems to be solved within the specific organizational framework. An organization then negotiates these processes through the fourth and final communicative flow – institutional positioning. Institutional positioning refers to external communication and the process of organizational self-reflection and its position in relation to customers and other organizations. According to the authors this communication flow is vital as organizations are embedded in existing social structure and human contexts and therefore need to find a way to position themselves in social, cultural and political contexts.

In conclusion, the Four-Flows Model is an attempt to describe organizational practices from a communication perspective. Four communication flows were described in order to shed light on divergent practices. The first flow focusses on organizational members, the second on decision making, the third on collaborative engagement and the fourth on external relations. McPhee and Zaug make clear that not all flows necessarily exist in every organization but that the model is a helpful tool to understand organizational systems through a communicative lens.

The third school of CCO thinking draws on Luhmann's theory of social systems. Luhmann's thoughts are especially popular and influential in German speaking areas. Luhmann's theory takes yet another approach by focussing on the concept of the observer. Following the notions of radical constructivism Luhmann writes that the world depends on the observer's perspective. Hence, the world is how the observer constructs it (Luhmann, 1995). Organizational communications scholar Schoeneborn places Luhmann's theory explicitly under the umbrella of CCO thinking and states that social systems theory contributes towards addressing how communication constitutes organizations (Schoeneborn, 2011).

Luhmann's comprehensive theory has been discussed extensively and is here therefore only mentioned for completeness. Luhmann's contribution to the field of communication represents the impact he has had on communication. At that point in time social theories mostly focussed on action. Luhmann, however, put communication and its coordination at the center of his work. He rejected the idea of transmitting communication as well as performing communication and put forward the idea that communication is a continuous process of selection performed by a system. Schoeneborn transfers this idea onto organizations by stating "that organizations are fundamentally grounded in paradox, as they are built on communicative events that are contingent by nature" (Schoeneborn 2011, p. 682). Hence, organizations are constantly enacting communicative events that may turn out in different ways. Within the three schools of thinking the definition of communication differs. While the third view drawing on Luhmann's theory refers to communication as information, the Monteral School focusses on the transactional dimension of communication. The Four-Flows Model in turn draws on the sociological fundament of symbolic interactionism stating that people act in relation to the meaning things have for them.

What makes the CCO approach valuable for this research and the reason for it being presented here is its notion that communication constitutes systems. That is to say that is it communication that is decisive within systems and that it is important to understand the communicative processes in order to understand the system itself. After presenting and summarizing communicative approaches to systems I will present the communicative framework that guides the empirical analysis.

### 3.4 Summary: Algorithmic media as algorithm-user-communication

This chapter started with the notion that news consumption behavior has changed. While traditionally news media prided themselves with spreading relevant news, nowadays relevant seems to be whatever reaches the user. Young users especially seem to have a strong belief in the wisdom of the crowds. For internet activists this trend causes discomfort. However, from my understanding, the contemporary news trend is critiqued on the false premise that algorithms are mechanical decision-making systems based on programmable factors. Hence, the goal of this chapter was to identify a conceptual framework that takes the algorithm-user relationship into account. In order to do so, I have placed this inquiry under the umbrella of internet studies. This is helpful insofar as it allows the required openness towards studying algorithmic media. More concretely, I have described influential texts that motivated this research.

A prominent notion in technology studies is that of the duality of technology. Conventionally, technical material and social usage are viewed as separate entities, however, recent studies aim to overcome this distinction. Further, I elaborated on the concept of technological affordance, which originated in the field of psychology. Today it is widely used to analyze users' perception of technology. Finally, I have discussed literature that critically engages in the social implications of algorithms. While initial literature in the field is rather activistic and pessimistic in its tonality, more recent analysis do also shed light on possible advantages. As stated in the introduction, for most users information overload is a constant factor in the digital realm. Therefore, the automated identification of relevant information also has the potential to be a helpful service. At the core of the discussion, however, the question still exists of how relevant information is identified and what the fundamental mechanisms are.

Influential in studying the mechanisms of algorithms are functional approaches that frame algorithms as decision-making entities. This is why I addressed the roots of functional theories, especially general system theory, Shannon and Weaver's mathematical model of communication and cybernetics. System theory brought forth the notion of input, throughput and output. These concepts help in identifying different system states, though concrete processes are still black-boxed. Shannon and Weaver made an important contribution by laying out how communication can be electronically transmitted. This model later contributed to the view of communication being computer-mediated. Finally, cybernetics provided the missing link by introducing the notion of feedback. The notion of feedback helped to conceptualize technology as feedback systems. In the preliminary summary, I have argued that all these components can be found in current understandings of algorithms and I have therefore discussed the input-output-throughput model of algorithmic selection. While the functional understanding of algorithms is comprehensible, it fails to incorporate exchange and machine learning processes with and through the user. Hence, a communicative approach towards algorithmic media seems more suitable and valuable.

In this regard, media scholar Gunkel introduced the concept of the communicative other. He claims that through the increased use of artificial intelligence computers are no longer technological systems but active communicators. Communicators that confront the user and call for appropriate action. Subsequently, the CCO school of thinking is a valuable perspective to embed Gunkel's thoughts into a broader theoretical framework. The CCO approach studies communication as constitutive of systems. Instead of conceptualizing systems as black-boxes in which communication takes places, the CCO approach states that it is continuous episodes of communication that constitutes a system. For this study, this theoretical approach is helpful insofar as it opens the black of algorithmic factors and leads towards an inquiry into algorithm-user-communication. Hence, it is the constant algorithm-user-communication that constitutes information relevance.

To sum up, the conceptual framework that guides the following empirical analysis understands algorithmic media as algorithm-user-communication. It is the ongoing communicative process that creates information relevance. Hence, information relevance is not solely subject to programmable factors inherent in algorithmic systems but it is constituted by algorithm-user-communication (see figure 11).


Figure 11: Conceptual model algorithm-user-communication

# 4. Method and data analysis

The two previous chapters were concerned with algorithmic media and the digital realm (see chapter 2), and the conceptual frame of information relevance in algorithmic media as algorithm-user-communication (see chapter 3). As described in those chapters the greatest challenge when studying algorithmic media is its fast changing pace – the algorithms employed are constantly being updated and advanced, as is the internet as a digital space. Karpf (2012) points out: "Simply put, the Internet of 2012 is *different* from the Internet of 2002. What is more, there is little reason to suppose this rapid evolution is finished: the Internet of 2022 will likely be different from the Internet of 2012" (p. 1, emphasis in the original). Karpf's statement applies equally to information relevance in algorithmic media, and as argued before this constant state of flux needs to be taken into account.

In the following chapter, the outlined conceptual lens of algorithm-user-communication will be explored empirically through expert interviews. Before I present the findings of the expert interviews, this chapter elaborates on epistemological and methodological questions. Further, I will describe the process of data collection and how the data has been analyzed, and, more specifically, how it has been coded. In total, 25 interviews with programmers, users and media professionals were conducted. These expert interviews are slightly less standardized than guided qualitative interviews. This format was chosen to accommodate a greater variety in the expert knowledge collected. Programmers were interviewed as experts because their ideas and values influence the applied algorithms. Hence, these interviews give insight into how and why the employed algorithms are programmed as they are. Then, I interviewed users because their behavior and approach to algorithmic media plays a significant role and highly influences information relevance. They are experts in the sense that they are the ones navigating algorithmic media. Lastly, I conducted interviews with several journalists and media professionals as experts in the media field. This helped in gaining a deeper understanding of ongoing public discussions.

Every method requires certain assumptions to be made about the structure of the world, and the expert interviews are no different. These assumptions need to be made explicit in order to bring biases to light and to increase the accuracy of the conclusions. I do so by locating this research in the qualitative paradigm (see section 4.1). The term paradigm might be considered slightly outdated with respect to the emergence of mixed method approaches. However, I use the term as a defining characteristic to situate this research in the specific field of qualitative research. This is not to place qualitative methods in opposition to quantitative methods but rather to take a distinct approach towards what is considered as data. As the goal of this research is *verstehen* the qualitative approach appears to be most suitable. After discussing the epistemological premises of qualitative research, I present the applied method for conducting expert interviews according to Bogner, Littig and Menz (see section 4.2). I then discuss the notion of who can be considered an expert in what, and explain the process of data collection, interview inquiry and the employed interview guideline (see section 4.2.1). For quick reference, I summarize all interviews in a table (see table 12).

The conducted interviews were transcribed following the guideline shown in figure 13 and therefore in the analytical process they are treated as texts. In total, the interview transcriptions yielded in approximately 500 pages. The texts were coded within seven steps following Kuckartz' (2012) description of structured content analysis. The coding process as an analytical strategy and preliminary codes are shown and described in more detail in section 4.3. Before concluding this chapter, I critically reflect in section 4.4 on the notion of 'Internet Time' (Karpf, 2012) and resulting implications for research designs in the social sciences. In general, the process of data collection and data analysis follows a pragmatic approach, mostly because, like most research, this study was subject to financial limitations and time restrictions. This means that in practice certain analytical steps have more organic and performed in parallel.

### 4.1 The "qualitative paradigm": General methodological considerations

Creating a research design entails creating a generic plan that guides and limits the process of data collection. Hence, the empirical method functions as a tool to gather data systematically and rigorously. In this exploratory research the focus lies on the explication of knowledge rather than its reproducibility. Therefore, methods in the qualitative paradigm are especially suitable as their focus is description. Here, it is important to note that qualitative and quantitative research methods are not mutually exclusive but integrative; in the words of Wolcott (2001) "two sides of the same coin". In the past, as methods of inquiry they were described as opposing; however, in recent decades the increasing popularity of triangular methods has started to bridge this notion. Flick (2007) argues in this regard that qualitative methods come with specific attributes:

> This profile is no longer defined ex negativo – qualitative research is not quantitative or not standardized or the like – but it is characterized by several features. Thus, qualitative research uses text as empirical material (instead of numbers), starts from the notion of the social construction of realities under study, is interested in the perspectives of participants, in everyday practices and everyday knowledge referring to the issue under study. (p. 2)

The notion of paradigm can be traced back to Kuhn, who is one of the most influential thinkers in this respect. Kuhn (1963) proposed that when most of the researchers in a specific research field agree on common epistemological and methodological postulations then this discipline can be called scientific. However, within a wider field of scientific research several paradigms may coexist. That is to say the research field is the same but shared epistemological and methodological postulations differ; sometimes they may even be contradictory. Schoeneborn (2008) briefly summarizes the function of Kuhn's paradigms as follows:

> (1) they serve as *spotlights* which means that they enable their followers to identify a certain set of problems and they usually also deliver a certain set of tools how to approach these problems, (2) they are *universalistic* in their ambition which means that they claim to be in principle applicable to all kinds of problems covered by the discipline, (3) they require some form of *consensus* by a group of researchers who follow the paradigm in its most basic assumptions, and (4) they are *incommensurable* which means that they usually cannot be easily combined with other paradigms due to mutually contradicting epistemological and methodological assumptions (emphasis in the original, p. 29).

Following Kuhn then means that applying methods in the qualitative paradigm includes the acceptance of certain postulations about the world, on which I elaborate below.

The field of qualitative research has a long tradition. At the beginning of the 20th century Wilhelm Wundt was one of the first researchers who systematically used strategies of interpretation (Fahrenberg, 2008). It was only later, during the so-called "science wars", that qualitative research was formulated in opposition to quantitative methods. This qualitative versus quantitative debate can be traced in the works of Karl Popper and Ernst von Glasersfeld, who can be placed at the two endpoints of a continuum. Popper (1983) distinguishes between objective and subjective knowledge. The latter is subject to the senses. Popper argues that subjective knowledge is guided by individual beliefs, which are needed to ensure individual security. In contrast, objective, or what Popper calls scientific knowledge, follows the principle of falsification. This means that hypotheses are established and tested against their falsification. This quality criterion is used to ensure that knowledge gained is true in a wider sense and independent of the researcher. Glasersfeld, on the other hand, co-founded a research tradition called radical constructivism. Glasersfeld (1990) rejects objective truth and the true knowledge that Popper suggests exists. This is one of the reasons that he calls his theory a "theory of knowing" rather than a "theory of knowledge": his emphasis is on the processual nature of knowledge. Glasersfeld states that knowledge cannot exist outside of individual experience. Therefore, he understands knowledge as subject to social construction. More concretely, he bases his idea on the thoughts of Piaget, who states that knowledge cannot be received passively but needs to be acquired actively within the cognizing subject. From this point of departure Glasersfeld argues as follows:

> If the view is adopted that "knowledge" is the conceptual means to make sense of experience, rather than a "representation" of something that is supposed to lie beyond it, this shift of perspective brings with it an important corollary: the concepts and relations in terms of which we perceive and conceive the experimental world we live in are necessarily generated by ourselves. In this sense, it is we who are responsible for the world we are experiencing. As I have reiterated many times, radical constructivism does not suggest that we can construct anything we like, but it does claim that within the constraints that limit our construction there is room for an infinity of alternatives. (Glasersfeld 1990, p. 28)

The citation shows the consequences that follow an epistemological position. If one accepts that knowledge and theories exist independently, the research and the findings take on another form and must be designed accordingly. Wolcott (1994) speaks in this regard of the transformation of data. This means findings need to be interpreted in the light of the researcher's experience. Therefore, research-in-practice typically takes a somewhat pragmatic approach. In the case of this research it is important to note that the applied method of expert interviews comes with the underpinning that the knowledge gathered relates to me as the researcher as well as my interview partner. The knowledge is not "out there" per se; rather, it takes shape during the interview. It needs to be acknowledged that the way in which questions have been asked and how I as a researcher engaged in the conversation has influenced the outcome, even though I tried to be as neutral as possible. As the goal of this research is to broaden and explicate knowledge about algorithmic media, the quality criterion of reproducibility plays a minor role. This does not mean, however, that the developed knowledge is not generally applicable. On the contrary, I have chosen to approach algorithmic media with the method of expert interview exactly because this was the best way to gain a deeper understanding of the ongoing processes between algorithm and user.

In conclusion, this short inquiry into underlying epistemological assumptions of the qualitative paradigm shows that the method is not separable from its characteristics. After careful consideration, I have nonetheless decided that expert interviews is the most suitable method to gain knowledge about algorithm-user-communication. Exploratory expert interviews indicate by definition that the information collected from individuals will simultaneously represent a number of others in the field. Bogner and Menz (2009) write that in this case interviewed experts can be understood as "'crystallization points' for practical insider knowledge" (p. 2). Interviews in general and expert interviews in particular help to explore the object of study in an efficient and concentrated way. Additionally, as stated above, they are located in the qualitative paradigm. Within this paradigm knowledge is understood as subject to social construction, which means knowledge is not a social fact but created through interpretative processes.[19] Hence, knowledge is not independent of, but linked to, the constructing subjects. This applies not only to the researcher and her interviewees, but to the readers of this study as well. Beyond this, the explicated knowledge is bound to interpretative frames of meaning (Giddens, 1984). Depending on prior knowledge these interpretations may vary. What this research offers is conceptual knowledge – conceptual knowledge in the form of a 'model-to-think-with' that allows users and researchers to better navigate through and with algorithmic media. The following outline of the method used and the empirical material gathered should thus be understood within this constructivist framework.

19 Berger and Luckmann (1966) have described this process as the "social construction of reality".

## 4.2 Research method: Expert interviews

In a constructivist framework, then, knowledge is subject to individual frames of meaning. This does not mean, however, that knowledge is arbitrary. On the contrary, it is bound to its subject. This also applies to the method of expert interviews, where knowledge is constructed during the interview rather than existing independently. The entire process of data collection is oriented towards answering the research question. Below I reflect in more detail on the method employed to conduct expert interviews and the process of collecting data.

In the very beginning the project idea was to gather data via participant observation. However, this turned out to be unfeasible in practice. One of the reasons was that the producers of algorithmic media are scattered around the globe. Even more importantly, algorithms are coded via programming languages. This means my observation would have been of a programmer typing code on a computer screen. That would undoubtedly have been interesting, but my knowledge of programming languages is too limited for such an undertaking. Throughout this initial approach, however, I learned how important the user is, and that the application is driven by actual or perceived users' needs. The companies I visited strive for a satisfying user experience, which means a variety of things. First and foremost, it means that users must use the application in order for the producers to gather feedback through data such as page impressions and number of users. Within this initial phase of the research the focus changed from algorithmic structure towards the algorithm-user relationship. This is of particular importance because the user is what Marwick and Boyd (2011) call the "imagined audience" (p. 115)[20]. They write that "[t]echnology complicates our metaphors of space and place, including the belief that audiences are separate from

20 Marwick and Boyd use the concept in a different context. Their starting point is users who write on Facebook and Twitter to an "imagined audience". In order to image the audience participants take online cues. This practice is very common in the digital realm and within marketing, where the personal contact with customers decreases.

each other. We may understand that the Twitter or Facebook audience is potentially limitless, but we often act as if it were bounded" (p. 115). The producers of algorithmic media imagine typical users as a reference point, but they have almost no contact with them. Some companies did their user research in the starting phase, when no real-time data was available. This resulted in so-called user models (see Chapter 2), that were only the starting point for the process of creating information relevance in algorithmic media. In order to gain more knowledge about the programming process, I therefore switched to the method of expert interviews. This was the better option for a comprehensive inquiry.

Qualitative interviews in general and expert interviews in particular are well established methods within social science research. In this study they are employed to explore the communicative dynamics of algorithmic media. To my knowledge the most comprehensive work on expert interviews is presented by Bogner, Littig and Menz (2009). In their book, they explore current trends in the debate on distinct notions of experts and expertise from different perspectives. The main topic of contention is who can be considered an expert and, thus, who falls into the category of interviewee. The choice of who to interview significantly influences the research result. Meuser and Nagel (1997) state that most of the literature is on how to access the field and how to conduct the interview. However, methodological considerations such as who qualifies as an expert remain largely untackled. Bogner and Menz (2009) identify in this relation three issues, which I reflect on below:

(1) Who qualifies as an expert?

(2) What specific form of expert interview is conducted?

(3) What are the specifics of the conducted expert interview in comparison to other qualitative methods?

### (1) Expert vs. expert

Who qualifies as an expert is one of the predominant questions when considering the method of expert interview. In this regard, Flick (2007) points out that "the interviewee is of less interest as a (whole) person than in his or her capacity of being an expert for a certain field of activity" (p. 92). The definition of expert limits or expands the number of potential interviewees. Boger and Menz argue that the concept of expert is strongly related to the concept of knowledge. They identify three different categories, or concepts, of expert: (1) the voluntaristic, (2) the constructivist and (3) the sociological. They are analytically distinct in the sense that they all relate to different conceptions of knowledge:

> The *voluntaristic concept of the expert* starts from the undeniable fact that every human being is in possession of particular information, capacities and so on which equip them to deal with their own everyday life; one can thus speak in a general sense of a specific advantage in terms of knowledge relating to personal arrangements. (emphasis in original, p. 49)

The concept is characterized by the fact that in certain aspects of life everybody is an expert, specifically in the way they live their own life. In this concept knowledge is distributed rather unevenly between the expert and the interviewer, and this raises the question of why the specific method of expert interview would be applied when other forms such as the narrative interview seem more suitable. The term expert may therefore not serve as an effective selection strategy when researching knowledge that is highly individual and bound to one's life story.

The constructivist approach to defining an expert focuses on "the mechanisms involved in the ascription of the role of expert" (p. 49). In this understanding the researcher anticipates a specific form of expert knowledge, which is of importance to the researcher. In this way, experts are defined not only through their expertise but also by the researcher, who ascribes expertise in a certain field to a certain person. Bogner and Menz (2009) note that it is important that a researcher is "never at liberty to select just anyone as an expert" (p. 50). Typically, researchers follow established indications of societal recognition of expertise such as having published relevant literature or having a distinguished role in a specific organization.

The third perspective on experts is the sociological approach. Bogner and Menz (2009) refer in this case to Schütz (1946) and his "well-informed citizen", to whom I also refer in the greater argument of this research (see Introduction). Schütz (1946) mentions three ideal types of citizens: (1) the expert, (2) the man on the street and (3) the well-informed citizen. About the expert he writes: "The expert's knowledge is restricted to a limited field but therein it is clear and distinct. His opinions are based upon warranted assertions; his judgments are not mere guesswork or loose suppositions" (p. 465). In the sociological perspective knowledge is understood as distinct knowledge within a specific field.

Within all these concepts being an expert means to posses distinct knowledge that is difficult to obtain otherwise. Therefore, researchers set out to interview identified experts to gain access to this type of knowledge. Bogner and Menz further distinguish expert knowledge in types of (1) technical, (2) process and (3) interpretative knowledge. Interpretative knowledge can be equated with phronesis, which Flyvbjerg (2001) argues for in his book *Making Social Science Matter*. Phronesis is knowledge in the form of practical wisdom; it "involves judgments and decisions made in the manner of a virtuoso social or political actor" (p. 2).

Phronesis is the type of knowledge the experts I have interviewed operate with knowledge that evolves out of everyday practice, specifically trial and error. Programmers especially do not have set concepts in mind in the way one might think. Usually, they try to work out how users are adopting the product. Therefore, the type of knowledge I am striving for is knowledge that on an abstract level is similar but on a personal level is highly individual and therefore may vary greatly. In this research experts were identified through their roles in organizations and by their expertise in the field. This type of knowledge exists in the programmers' minds; in other words it is constructed during the interview and it is hard to imagine how else it could be accessed. Bogner and Menz call this type of knowledge gathering "analytic construction" (p. 53). The knowledge is formulated and made explicit throughout the interview and is therefore analytically constructed in the context of the interview. In other words, it becomes conscious. The expert knowledge is further subject to analytical interpretation, which is the "result of an act of abstraction and systematization performed by the researcher" (p. 53). Again, this does not mean that knowledge or methodological processes are arbitrary; on the contrary, through the act of interviewing they become tangible.

The same type of expert knowledge is gathered through the interviews with users and media professionals. Media professionals are experts in their profession by definition. Users are experts in using the service. Therefore, I only conducted interviews with users who had sufficient experience with algorithmic media (see also section 4.2.1).

### (2) Interview strategy

After reflecting on what type of knowledge is desirable from the researcher's perspective, the next question that emerges is how to arrange the interview situation in the best way to acquire the desired knowledge. For this, Bogner and Lenz (2009) propose an "interaction model" (p. 68-69), stating that there is no one best way to conduct an interview, but propose a number of possible strategies for expert interviews. Specifically, they distinguish six roles of the interviewer: (1) interviewer as co-expert, (2) expert from a different knowledge culture, (3) interviewer as layperson, (4) interviewer as authority, (5) interviewer as accomplice and (6) interviewer as potential critic. Which of these roles is taken will affect the communication situation, the preconditions on the interviewer's side, the interview and question style, the advantages and disadvantages and the main area of application.

In practice the lines between the six roles often blur, however, I was striving for roles 5 and 6; interviewer as accomplice and interviewer as potential critic. Even though Bogner and Menz do not recommend the sixth interview situation, because of the "danger that the conversation will be broken off" (p. 69), I found myself in that role as interviewees were open to reflecting on their practice. Some of the interviewees were very interested in the ongoing debate about their services and engaged in lively discussion. Most of them had valuable contributions to make to the debate, especially when it came to critiquing traditionally mainstream media. For most of them this had been a major motivation to start working in the field of algorithmic media. Beyond this, two of the CEOs were facing lawsuits at the time of interview, because they were apparently using content unauthorized. In my role as the interviewer during the research, I tried to stay as open as possible. I would explain prevailing normative standpoints, which none of the interviewees shared. In other words, the interviews were conducted against a background of divergent knowledge bases and sometimes several explanations were needed until the interviewee understood the types of questions being asked. During the interviews further insider knowledge was revealed. This means that interviews were personal rather than formal. Bogner and Menz (2009) write in this regard that the "interview is conducted in a 'personal' style and everyday language is used; [there is] repeated confirmation of common ground" (p. 69).

### (3) Specifics in comparison to other qualitative methods

I mentioned above that the methodological and epistemological grounding of the expert interview is still under debate and therefore recommendable only under specific circumstances. This study is one of those cases. Other methods of collecting data in the qualitative paradigm include the qualitative interview, the narrative interview, the ethnographic interview, the guided interview and the structured interview. The main difference between these formats and the expert interview is the perspective of the interviewee. As discussed above, an expert interviewee is understood as somebody with “specific knowledge stocks, or [of] particularly exclusive, detailed or comprehensive knowledge about particular knowledge stocks and practices” (Pfadenhauer 2009, p. 81). This means that interviewees represent a specific form of knowledge. In the case of this study it is knowledge about algorithmic media. Hence, they do not only reflect on personal strategies as interviewees in a narrative interview do; they also represent and engage in knowledge on a more abstract level. Pfadenhauer distinguishes between (1) the knowledge of experts and (2) the competence of experts. Following Pfadenhauer’s distinction, the expert has not only technical knowledge in a specific field but “not generally available problem-solving knowledge” (p. 82). In my study this means that I chose interviewees who have not only what Pfadenhauer calls “overview knowledge” (p. 82) but also relevant knowledge in the field of algorithmic media. Pfadenhauer describes relevant knowledge as “more comprehensive knowledge that enables him not only to solve problems, but moreover to identify and to account for problem causes as well as for solution principles” (p. 82).

To find experts in the field of algorithmic media was relatively simple. Most businesses are very small, still in their start-up phase and therefore are mostly run by programmers. Hence, the programmers qualified as expert interviewees, because they were the ones coding and developing the service. Finding users and media professionals to validate and contest the gathered knowledge was slightly more difficult. A user was defined as an expert when he or she was familiar with one of the identified algorithmic media services (see section 4.2.1) and had been using them for at least one month. Experts were identified through comments they had made online or in digital publications in relation to the topic of algorithms and social implications of algorithms. When approaching journalists as interviewees, I contacted only journalists who had explicitly published on the topic. This helped to ensure expert knowledge when selecting interviewees and to filter out other types of interview mentioned above.

### 4.2.1 Process of data collection, interview inquiry and interview guideline

Having reflected on epistemological and methodological considerations, I will now describe how the research was conducted in practice. Funds for the study were limited, which meant many pragmatic choices. Nonetheless, the aim is to adhere to scientific rigour and transparency. The practical process described below is structured according to (1) the process of data collection, (2) the interview inquiry and selection of interviewees and (3) the interview guideline.

#### (1) Process of data collection

The data collection took place in four phases:

(1) Exploratory phase – Preliminary study

(2) Technical phase – Interviews with programmers

(3) User phase – Interviews with users

(4) Saturation phase – Contextual interviews with media professionals

The first interview took place with a well-known German blogger and programmer an was conducted in the framework of a course I taught at the University of Erfurt. The main function of this interview was to test the identified areas of interest drawn from the literature and to look at first considerations in regard to the operation mode of algorithmic processes. After this interview the interview guideline was finalized (see figure 13). Then, the second set of interviews were held. During this phase I solely interviewed programmers and experts involved in the production process of algorithmic media. During the third phase I primarily talked to users. In the final phase, the so-called "saturation phase", I conducted interviews with industry experts and journalists. Throughout the research process interviews with the following companies took place: (listed in alphabetical order):[21]

21 Even though Facebook and Twitter serve as examples of algorithmic media, for this study I did not approach them directly as there is extensive research on them.

(1) Allmypress, Hamburg – www.allmypress.com

(2) Commentarist, Hamburg[22]

(3) Genieo, Herzlia Pituach, Israel – www.genieo.com

(4) My6thSense, Tel Aviv, Israel – www.my6sense.com[23]

(5) News360, Moscow, Russia – http://news360.com

(5) Scoopinion, Helsinki, Finland – www.scoopinion.com

(6) Tazaldoo, Berlin, Germany – www.tame.it

### (2) Interview inquiry and selection of interviewees

The selection process of interviewees falls under the broader label of theoretical sampling. Glaser and Strauss (1967) have developed a concept of theoretical sampling that can be used as a guideline on how to collect and interpret data:

> Theoretical sampling is the process of data collection for generating theory whereby the analyst jointly collects, codes and analyzes his data and decides what data to collect next and where to find them, in order to develop this theory as it emerges. This process of data collection is controlled by the emerging theory. (p. 45)

Initially, I had identified five companies as producers of algorithmic media via internet research, again I went after number of users and popularity. All of these companies were identified through their websites. The main indicator identifying them as algorithmic media was the presence of an automated information feed based on algorithmic processes. All of the companies approached described their product in detail on their website, making them fairly easy to find. I approached all companies via e-mail (see appendix A), using the e-mail address provided in the 'Contact Us' tab on their website. The first company I approached responded within one day, all the others even sooner. I was able to set up all interviews quickly, and all companies seemed very approachable. Only one company did not agree to a face-to-face interview. They cited lack of time as the reason but agreed to a written interview via e-mail. I tried to gather

22 This company had to stop their services due to copyright issues throughout this research.

23 One of the programmers I interviewed switched his workplace to Twitter during the time of research.

as many interviews as possible face-to-face. This entailed a fair amount of travel, especially during the first phase, to the locations of the companies. All interviews in Germany took place face-to-face. Later, due to financial restrictions I conducted follow-up interviews via Skype (see table 12).

The first four interviews took place within the same company. The programmers were very open and approachable, even though they also seemed slightly irritated by my rather basic technical questions. Many did not know or did not understand the normative discussion outlined in the introduction and therefore it took a while to find common ground for the interviews. The more familiar I became with the technical terms used in the field of programming, the easier the interviews became. The first interviews with programmers all took place on site in Tel Aviv, Israel, because back then I was still following the idea of observational research. After gaining a thorough understanding of the technical side of algorithmic media, I approached users via Twitter and Facebook networks. In particular, I looked for users who had posted about the interviewed companies (see appendix B). This way I could make sure that they were familiar with the services and had experience in using them. I purposefully approached people who had used the products and hence were able to talk about their user pattern.

In total, I approached 29 users and completed eight interviews. When gathering interviews I followed again the pragmatic approach. Flick (1998) writes in this regards: "It is their relevance to the research topic rather than their representativeness which determines the way in which the people to be studied are selected" (p. 41) and Kvale (1996) who advises researchers to interview "as many subjects as necessary to find out what you need to know" (p. 101). However, this approach has implications for the generalization of the findings, which I discuss further in section 4.4.

The last phase took place in the month following the third phase. These interviews provided context for the interviews gathered and helped create a more cohesive picture. It is important to note that even though the description of the process sounds quite linear it was in reality fairly iterative. During the process of making sense of the research I often went back to see if conclusions drawn still made sense in light of the interviews that came later. The following table 12 summarizes the interviews made:

| No. | Inter-viewee Code | Expert | Location | Mode | Langua-ge | Function |
|---|---|---|---|---|---|---|
| 1 | AMP 1 | VP R & D | Herzlia Pituach, Israel | In person | English | Inquiry into algo-rithmic processes |
| 2 | AMP 2 | CEO | Tel Aviv, Isreal | In person | English | |
| 3 | AMP 3 | Founder | Tel Aviv, Isreal | In person | English | |
| 4 | AMP 4 | Programmer | Tel Aviv, Isreal | In person | English | |
| 5 | AMP 5 | Programmer | Tel Aviv, Isreal | In person | English | |
| 6 | AMP 6 | Founder | Moscow, Russia | Written | English | |
| 7 | AMP 7 | Product Desig-ner/Engineer | Helsinki, Finland | Skype | English | |
| 8 | AMP 8 | Founder & CEO | Berlin, Germany | In person | German | |
| 9 | AMP 9 | CEO | Hamburg, Ger-many | In person | German | |
| 10 | AMP 10 | Co-Founder | Hamburg, Ger-many | In person | German | |
| 11 | AMU 1 | User | Lüneburg, Germany | Skype | German | Inquiry into user approa-ches |
| 12 | AMU 2 | User | Hamburg, Ger-many | Phone | German | |
| 13 | AMU 3 | User | USA | Skype | English | |
| 14 | AMU 4 | User | USA | Skype | English | |
| 15 | AMU 5 | User | Spain | Skype | English | |
| 16 | AMU 6 | User | Hamburg, Ger-many | Skype | German | |
| 17 | AMU 7 | User | Berlin, Germany | Skype | German | |
| 18 | AMU 8 | User | Singapore | Skype | English | |

| No. | Inter-viewee Code | Expert | Location | Mode | Langua-ge | Function |
|---|---|---|---|---|---|---|
| 19 | AS 1 | Scientist | Copenhagen, Denmark | In person | English | Context know-ledge |
| 20 | MP 1 | Media professi-onal | Copenhagen, Denmark | In person | English | |
| 21 | MP 2 | Media professi-onal | Zurich, Switzer-land | Phone | German | |
| 22 | J 1 | Journalist | Munich, Ger-many | Skype | German | |
| 23 | J 2 | Journalist | Zürich, Switzer-land | Skype | German | |
| 24 | J 3 | Journalist | Berlin, Germany | Skype | German | |
| 25 | J 4 | Journalist | New York, USA | Skype | German | |

Table 12: List of interviewees

The used abbreviations stand for:

(1) AMP: Algorithmic Media Producer

(2) AMU: Algorithmic Media User

(3) AS: Scientist in the field of algorithms

(4) MP: Media professional

(5) MJ: Algorithmic Media Journalist

### (3) Interview guideline

The interview guideline, as mentioned above, was developed prior to the first interview and tested during the preliminary study. Because of the exploratory nature of the research design, I spent little time in formulating detailed questions and used the interview guideline only during the first five interviews to make sure all areas where covered. In later interviews, I used the interview guideline less and less, especially as answers began taking on similar themes. In those cases, I asked related questions or skipped certain sections entirely. Interviews with users took place in the context of the technical knowledge gathered, and the interviews of the final phase were conducted to saturate the insights gained. Therefore, I did not prepare an interview guideline but used notes from my research diaries.

| | |
|---|---|
| A | **Short introduction of the research project** |
| B | **Company/service** |
| | (1) Description of the service in their own words, (2) Philosophy, (3) Market position, (4) Competitors, (5) Societal relevance, (6) Background/history of company/product |
| C | **Technology in general** |
| | (1) Operation mode, (2) Influencing factors, (3) Decision-making process (4) Influential factors |
| D | **Algorithms in particular** |
| | (1) Operation mode, (2) Transparency, (3) Form of selection |
| E | **Algorithmic selection/algorithmic personalization** |
| | Clarification of concepts |
| F | **Effects** |
| | (1) Societal effects, (2) Processes of societal change, (3) Effects on news processes, (4) Algorithmic determinism |

Figure 13: Interview guideline

### 4.2.2 Process of interview transcription and transcription guideline

All interviews were analyzed in the form of written text. Therefore, all interviews except one, which was conducted via e-mail, needed to be transcribed. I transcribed the first three interviews myself; after that I employed student helpers. In order to guarantee uniformity in the data, a simple transcription guideline was established (see figure 14) that could account for my informants' verbal peculiarities. The fit of the audio recording and interview transcript were checked randomly. Partly, spelling mistakes were corrected in the transcription files. After the transcription process, interviews made anonymous were it was necessary. This means in those cases actual names were replaced by general formulations such as [company name], [founder] or [programmer].

1. The transcription shall be carried out word by word. This means, dialects or other verbal perticularities are not considered. However, this also means that answers, especially long answers, are not summarized but transcribed literally.
2. Language and punctuation may be smoothed, especially when duplications occur frequently. This means, if a sentences starts with "I mean ... aahhmm I mean" it is ok to transcribe "I mean" once.
3. Significant and long pauses are marked either via three points ... or three points in parenthesis (...). Depending on the length of the break the parentheses my include one, two or three points or in case of a very long break it can be used twice.
4. Affirmative statements of the interviewer do not need to be transcribed if they do not interrupt the flow of speech of the interviewee.
5. Statements and paragraphs of the interviewee are labeled through [B:]. Statements and paragraphs of the interviewer are marked through [I:].

6. Each statement is a separate paragraph to ensure readability.
7. Disturbances or quality issues are noted in parenthesis stating the cause or with question marks (?).
8. Unintelligible words shall be marked.

Figure 14: Transcription guideline, adapted from Kuckartz (2012, p. 136)

## 4.3 Systematic coding as an analytical strategy for the data analysis

Throughout the process of data gathering and interview transcription I started to analyze and categorize the collected material relatively quickly. For open-ended research this systematic coding turned out to be the most suitable strategy for data analysis, because it is simultaneously systematic and open. Coding refers to the systematic identification of essential concepts and their relationships. The strategy of coding holds the advantage of preventing bias while at the same time it creates a challenge: balancing the benefits of gaining a deep understanding of the material, while ensuring scientific rigour. This means it is crucial to document the process of data analysis as transparently as possible. To ensure scientific rigour I followed Kuckartz's (2012) schema of structured content analysis (see figure 15). With this, I was able to immerse myself in the data using a systematic approach.

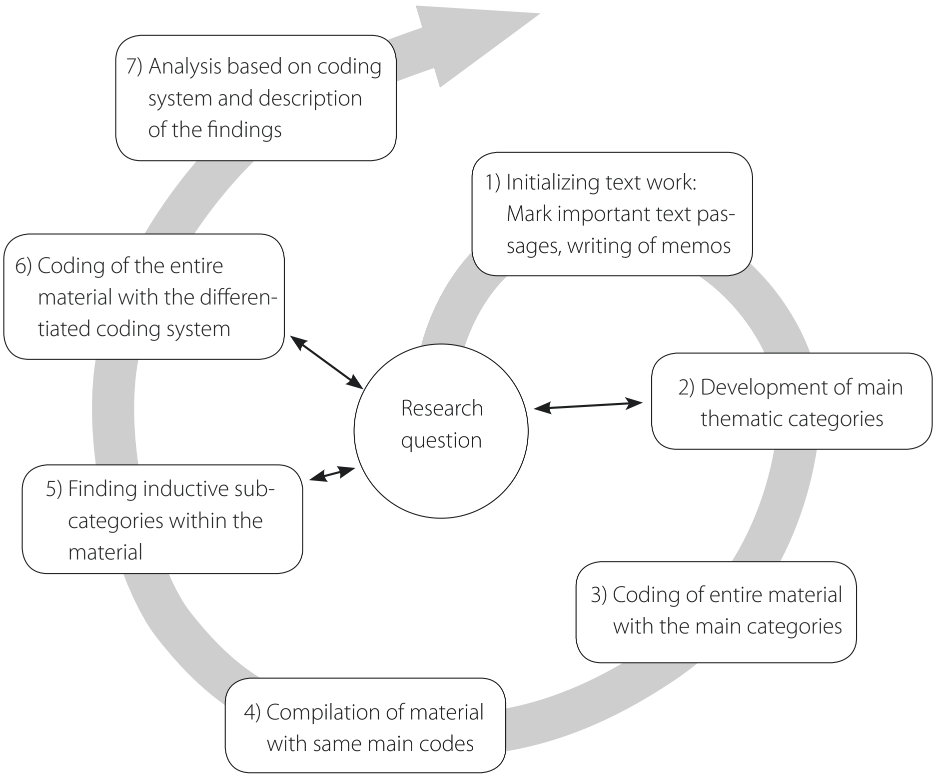



Figure 15: Process of structured content analysis (cf. Kuckartz, 2012, p. 78, own translation)

According to Kuckartz, a structured content analysis follows seven iterative steps. The first step is to mark important text passages and write memos or notes. Within the next step, emerging themes are put forward. Then the material is coded in relation to these main categories and gathered under the codes. After this, broad sorting subcategories are identified and the data is coded according to the refined schema. After several iterations, description and analysis of the data can begin. However, what is analytically distinct becomes blurred in research practice. In the beginning, I tried out several programs such as MaxQDA and Dedoose; however, due to licensing problems and their incompatibility with my operating system I ended up using the Word outlining function as Baym (2012) recommends. As Flick (1998) points out, coding is typically the first step towards the development of theory:

> Categorizing in this procedure refers to the summary of such concepts into generic concepts and to the elaboration of the relations between concepts and generic concepts or categories and superior concepts. The development of theory involves the formulation of networks of categories or concepts and the relations between them. Relations may be elaborated between superior and inferior categories (hierarchically) but also between concepts at the same level. (p. 179)

However, the goal of this research is the exploration of the algorithm-user-relationship rather than the formulation of theory. Therefore, a pragmatic approach towards data analysis turned out to be most useful. This pragmatic approach included printing the interview material and marking relevant text passages. At the same time, I wrote down comments, notes and questions that arose next to the individual passages in a research diary. The second step then was to make judgments about the relevance of the underlined passages and find thematic categories within the material. During the first coding process, I stayed as close to the original material as possible. During the next few processes I started to find more abstract codes. Then, I re-coded everything. The intermediate codes are shown in table 16. Before the final analysis as laid out in Chapter 5, I went through Kuckartz' coding process at least five times. Individual passages were coded even more often until saturation began to take shape.

| Main categories | Sub-categories |
|---|---|
| MODALITIES OF NEWS/ INFORMATION CON-SUMPTION | acceptance // active consumption vs. passive consumption // consumer behavior // understanding of the user // devices matter // duality of the user // education // expectations // intention of technology //use // interests // linearity vs. complexity // media handling //personal interest // socialization // technological dominance vs. consciousness |
| TECHNOLOGICAL MODE OF OPERATION | Algorithmic reasoning: why is vs. not this // Algorithmic technology behavior vs. content // collective vs. individual determinism // factors that go into the user model/functionality of the software // implicit-explicit feedback // interaction // level of complexity // what is the technology made for? // user model // referencing |
| FEELINGS CONNECTED TO THE USAGE | anxieties/control - data? // needs for assurance // security // power // pow-erlessness // question of control // responsibility // accountability // trust |
| PERSPECTIVES ON TECHNOLOGY | Area of software implication // Assumptions the software is based on comparison with traditional media // Definition of algorithm //question of control // regulation social vs. technology talk //words used? |
| MODALITIES OF CONTENT | content quality // content specific // content vs. medium // news vs. information // objectivity // relevant vs. irrelevant content // role of news in the world // scale/benchmark/quality // relevance // perspectives: 'useless junk' |
| IMAGINING A DEMO-CRATIC WORLD/UNDER-STANDING | Democracy // Fragmentation // relation between public and public opinion // societal relevance // thinking in majorities vs. special interests // transparency - only programmer can understand? too complex? // What is an informed citizen? |
| DUALITY OF THE USER | User as person vs. user as behavioral models |
| PROFESSIONAL UNDER-STANDING/PERCEPTION OF SELF | Handling of routines/journalistic routines // Job description // Perception of the role // What is the job all about? // Personal motivation: 'make things better''I like technology''I don't want to control the world''mind like a com-puter programmer' // professional ethics // sense of self |

Table 16: Preliminary codes and sub-categories

## 4.4 Research revisited and notes on the generalizability of the findings

As mentioned in the introduction to this chapter, the internet changes continuously, both as a communicative space and as a research site. Karpf (2012) connects this ongoing process with the concept "Internet Time". By building on Wellman's idea that an "Internet year is a like dog year, changing approximately seven times faster than normal human time" (Wellmann, 2001 in Karpf, 2012, p. 639) Karpf makes the argument that "Internet Time" has not found sufficient consideration within current research.

> 'Internet Time' is a subject grudgingly acknowledged in our research designs, rather than incorporated within them. Members of the interdisciplinary research community are aware that the suite of technologies collectively referred to as 'the Internet' continues to develop. But that awareness rarely becomes a feature of our research methods. (p. 640)

Karpf acknowledges that there is a general awareness of this speed of change but points out that it is not reflected in the social science researcher's methodological toolkit. He writes that "[s]tandard practices within the social sciences are not well suited to such a rapidly changing medium" (p. 640). What he means by this is that methodological and academic practices and standards take place in time frames that do not correspond with the speed of internet technology. Often, by the time of publication, material gathered is already outdated. Hence, as a partial solution Karpf suggests we consider "transparency and 'kludginess'" (p. 652). He writes:

> By transparency, I specifically mean that researchers should be up-front about the limitations of our data sets and research designs. This has always been a good habit, but it takes on additional importance in the context of Internet Time. (p. 652)
>
> '*Kludginess*' is a term borrowed from hacker culture. Wikipedia (appropriately) provides a definition: 'A kludge (or kluge) is a workaround, a quick-and-dirty solution, a clumsy or inelegant, yet effective, solution to a problem, typically using

> parts that are cobbled together'. The essence of a kludge is that it is inelegant, but usefully solves a problem. In the face of Internet Time, kludge design choices become particularly attractive. (emphasis in the original, p. 654)

Karpf points primarily towards research methods. For example, Twitter discussions can be recorded with quickly established databases, because otherwise tweets might get lost in the vast Twitter universe. Quick technological solutions to trace digital data will probably become even more popular. In this light, one might wonder why I chose to study such a fast-changing technology with such an intricate method.

One could almost say that within this study two extremes come together - algorithmic media, a research object in constant flux, is paired with a qualitative and somewhat laborious method. Although at first glance they seem ill-suited, from my perspective it is a valuable match. I do agree with Karpf's notion of Internet Time; nonetheless, social science researchers should not forget what detailed and in-depth inquiry can excavate. Instead of seeking ever faster methods and maybe even kludging a design together as Karpf describes, I believe it has become even more important to spend a considerable amount of time to understand technology and find adequate descriptions and theoretical frameworks. From my observation of ongoing discussions, scientific inquiry can make a valuable contribution through creating solid theoretical or conceptual perspectives. This applies especially to studies examining social implications of algorithms where only a partial understanding of technology exists. Often a theoretical framework narrows the perspective on the empirical data instead of keeping it open. A reason for this may be a lack of compatible theoretical frameworks. Therefore, my approach has been to start with a "kludge" conceptual framework to avoid theoretical assumptions from pre-internet times. This is where I believe Internet Time needs to be taken into account. Hence, kludge research designs are useful when collecting data, and kludge frameworks may be considered to ensure open perspectives when collecting data.

Hence, I chose the method of expert interviews because it contributes towards gathering conceptual knowledge and aims to provide a deeper understanding of technological processes. This might be an approach to consider in the field of artificial intelligence, where technology is evolving quickly and is mostly subject to business confidentiality. Instead of framing technology beforehand, I advocate openness until adequate technological descriptions are found. Finding programmers who are willing to share their knowledge might be one way to fathom some of the social implications of intelligent technology. However, finding programmers to talk to is one side of the coin. As users develop highly individual media strategies it is of no less importance to also take their views into account. Technology has become so complex that unintended consequences are no longer the exception but the rule. In a recent article Facebook stated that:

> [I]t [Facebook] may have tracked non-Facebook users who visited third-party sites with the Facebook "Like" button embedded without those Web surfers' knowledge, but attributed that tracking to a "bug" that is now being fixed. (Poeter, 2015, para. 1)

It remains to be seen if it was an actual bug or a purposeful strategy; however, it is a development that researchers need to take into account. This is demanding insofar as less than adequate ethical standards in a technique such as statistical sampling might be neither perceivable nor deliberate when placing technology at the center of the study. Another factor in Internet Time is the proliferation of new but similar platforms. During the time of this research the field of algorithmic media burgeoned. This might be an argument for kludge sampling strategies. Within this study I found my interview partners through Twitter and Google searches, and therefore the findings are not representative in a strict sense. However, the sample is representative insofar as it makes statements about algorithmic media as a digital phenomenon. That everything has become searchable increases transparency insofar as movements – including researchers' movements – have become traceable. However, for interviewees this might be problematic. Therefore, it is important to raise awareness of ethical guidelines. The Ethics Committee of the Association of Internet Researchers (AoIR) writes:

> Because 'harm' is defined contextually, ethical principles are more likely to be understood inductively rather than applied universally. That is, rather than one-size-fits-all pronouncements, ethical decision-making is best approaches through the application of practical judgement attentive to the specific context (...).
>
> Because all digital information at some point involves individual persons, consideration of principles related to research on human subjects may be necessary even if it is not immediately apparent how and where persons are involved in the research data. (Markham and Buchanan, 2012, p. 4)

As suggested by the AoIR, the key guiding principle of internet research should be the "balance of the rights of subjects (as authors, as research participants, as people) with the social benefits of research and researchers' rights to conduct research" (p. 4). Therefore, I chose to preserve my informants' anonymity even though the interviews were unlikely to increase their vulnerability, as I felt it was still important to guard their privacy. This raised the problem of how to manage the interviewees' digital privacy. My approach to finding informants is roughly documented via screenshots in the appendix. My decision not to present and document every single step was in order to protect their privacy. As probably every tweet is traceable, even though names and pictures are made anonymous I thought individual rights weighed higher than the social benefits of transparency. The issue of representivity is dealt with in section 4.1.

### 4.5 Conclusion

This chapter dealt with epistemological and methodological considerations. The employed method of expert interview is located within the qualitative paradigm. In the case of this study the qualitative paradigm is not understood to sit in opposition to the quantitative, but as an opportunity to gain insight into the research question. Generally, data collection followed the most practical course. This means that decisions were made based on their usefulness.

Expert interviews are an established qualitative method used to gain specific expert knowledge. They are used to generate knowledge that is not otherwise available. In this research this especially accounts for practical knowledge as it is translated into the technical operation of algorithmic media platforms. As a data collection method, the expert interview is slightly looser than other types of interview, and this ensures the openness required in collecting the data. Also worth emphasizing is that expert knowledge can be constructed during the interview and therefore does not exist per se. However, it is the function of expert interviews to produce knowledge by interaction that is not accessible otherwise. Within this study the notion of expert knowledge is an ascribed category; what made the interviewees experts is their constant engagement in the production or usage of algorithmic media. Programmers are experts in the technical operation of algorithmic media platforms while users are experts in how to approach them. Further, I interviewed journalists and media professionals, in other words experts in that field, and this provided context and insight into current debates crosscutting the sector.

As shown in table 12, in total 25 interviews with programmers, users and specialists were conducted. All interviews were recorded and transcribed following a transcription guideline. Hence, all interviews were treated as texts. The texts were analyzed following the process of structured content analysis proposed by Kuckartz (2012). Specifically, the seven steps of (1) initializing text work, (2) developing main categories, (3) coding the material, (4) compiling the coded material, (5) finding sub-categories, (6) Re-coding the material and (7) describing and analyzing the material, were followed. In practice the process was highly dynamic and iterative. To ensure scientific rigour, the coding process took place at several different points along the way. A preliminary coding that was established halfway through the research process can be found in table 16.

Discussing the process of conducting qualitative research Wolcott (1994) distinguishes between description, analysis and interpretation. He points out that the three are interwoven throughout the research process and only take shape during the process of documenting the research. After describing the process of data collection, the analytical part follows in the next chapter (see chapter 5). Herein, I systematically describe the material gathered. The interpretation of the findings or, in other words, the integration of theoretical and empirical insights follows in chapter 6.

# 5. The communicative dynamics shaping information relevance in algorithmic media

The overall aim of this research is to shed light on information relevance in algorithmic media. Through a comprehensive examination of algorithms in practice (see chapter 2), it can be shown that information relevance in algorithmic media depends on both algorithmic performance and user behavior (see chapter 2). The established theoretical framework builds on this insight by understanding information relevance as a communicative process between the algorithm and the user (see chapter 3). On this basis, empirical material was collected in order to examine what then shapes this algorithm-user-communication. Drawing on an analysis of 25 expert interviews, the following chapter presents, describes and empirically substantiates the four identified dynamics. The presented findings are the result of systematic data collection followed by a qualitative coding process, which has been described and discussed in relation to relevant epistemological and methodological issues in the previous chapter (see chapter 4). During the process of data analysis, the following four dynamics were identified:

(1) Functional-strategic dynamic,

(2) Narrative dynamic,

(3) Knowledge-awareness dynamic, and

(4) Action dynamic.

The identified communication processes, which I have termed 'dynamics' to point to their constitutive role (see chaper 3), undergo constant transformation processes. They therefore need to be understood on a conceptual level rather than as empirical realities. It is furthermore important to point out that the identified dynamics are not mutually exclusive. However, for analytical reasons, their distinction is valuable because they help to shed light on the complex communication processes constituting information relevance in algorithmic media. In the following, I will now briefly introduce and delineate the identified concepts, and a thorough description and substantiation with empirical material will follow throughout the chapter.

The (1) first dynamic, which has been termed the functional-strategic dynamic, points towards the strategic objective and functionality of the algorithms. Initially, algorithmic media was designed to organize and structure information that is digitally available. The starting point for the development of such services has been the observation that users seem to be overwhelmed by the amount of digital information. According to the interviewed programmers, the digital abundance of information has led either to information overload or the opposite, a severe lack of information for the average user. Here, the producers of algorithmic media aimed to offer an automated solution which focuses on detecting relevant information from a user's perspective. This means that a piece of information becomes relevant once a user shows interest in it. To automatically detect and present identified information as relevant is the origin and main objective of algorithmic media and hence the functionality of the algorithms builds on this basic idea. In summary, the identified functional-strategic dynamic points to the specific objectives of the algorithmic media service, which then partially shapes information relevance.

The (2) second dynamic shaping information relevance in algorithmic media is what I have termed the narrative dynamic. Here, I argue that the specific language used to describe algorithms is highly influential in terms of how algorithmic media is publicly understood and perceived. Typically, algorithmic media is described with a specific marketing language that makes algorithms sound magical and all-encompassing. A picture of algorithms operating beyond human control is thus created, which makes algorithmic media appear to be a service that just "knows". Most users are equally surprised and anxious regarding the accuracy of algorithmic performance and it can be seen that narratives cultivated around algorithms create rather cryptic notions. The interview material shows that this narrative is partially created to mask a certain simplicity of algorithmic processes. This being said, it does not mean that the algorithms used are easy to build or maintain; on the contrary, it points to the high competitiveness of the market and the lack of precise language to address algorithmic procedures.

The (3) third dynamic, termed knowledge-awareness dynamic, refers to the knowledge and awareness of algorithmic performance. Both differ greatly amongst users and experts. The interview material shows that most users are unaware of algorithmic technology and thus lack an understanding of how algorithms operate. Some may even feel overwhelmed by the possibilities today's automation technology offers. Furthermore, many users and experts are highly critical of the intrusiveness of algorithmic media. There seems to be a general consensus that algorithms are hard to grasp and conceptualize. Algorithms are hence often taken for granted as fixed entities and this may even defeat the purpose of the intented algorithmic performance; when user interaction is sparse or lacking the performance of algorithms decreases.

The final and fourth (4) identified dynamic, which has been termed action dynamic, addresses the question of how algorithms are approached by their users. How do users deal with and relate to the constant changes and developments of algorithmic services? What are the work arounds? How do users deal with the information given to them? The interview material shows a gap between the technological principles that algorithmic performance is based on and actual user behavior. Most users are unaware of how their behavior influences algorithmic information relevance and they therefore tend to consume news rather than actively interacting with it. This raises crucial questions with regard to how algorithmic media can be approached in order to receive a comprehensive news overview.

Before describing and empirically substantiating the identified dynamics constituting information relevance in algorithmic media, it is important to reiterate that the identified dynamics are first and foremost analytical distinctions on a conceptual level. Describing and delineating the identified dynamics will help sharpen the understanding of how information relevance arises in algorithmic media and thus sheds light on the complex communication processes between algorithms and their users.

## 5.1 Functional-strategic dynamic

In the following section, I will present, describe and empirically substantiate the (1) functional-strategic dynamic. The communicative structure called functional-strategic dynamic points to the strategic goal behind the operating algorithms as well as the underlying assumptions. What are the algorithms designed for? What were the programmers' intentions during the development process and which alternatives were considered? The following analysis is carried out largely from the programmer's perspective. That is to say, the emphasis lies on how the programmers view their own product and how they explain algorithmic performance. The analytical description and empirical substantiation of the functional-strategic dynamic also aims to understand and shed light on the programmer's intention behind the algorithmic processes. This is valuable insofar as it is common practice to release technology in beta-versions. This means that the product is not tested exhaustively before it is released to the market but tested through its users while on the market. Modern technologies are constantly tested and developed and hence algorithmic media is also constantly a work-in-progress.

Although the companies are globally spread, all of them mentioned digital information overload as a general starting point for the development of their algorithmic service. According to their observation of the digital realm, users were lacking orientation when browsing the web. They observed that specific information was hard to find and so they started to look into various technical solutions. An important question for them was how, with the help of technology, users could find information more efficiently. One expert describes their initial ideas as follows:

> Within two years it will not double itself, it will be ten times more. And very fast we will feel that there is overload information in the information that is pushed to us. In the past, when people said, overload information, first of all overload information is not a problem, it's a challenge .... Because something that exists more than 50 years, it's not a problem, it's a big challenge. With challenges you need to deal with [them]. Very much with information overload. People speak about information overload for many, many years, it just changed the form. In the past there is too much information in the library, too much information in the web, too much information that I could find through Google and now there is too much information that is pushed to me. Ok. So it was clear to me, that people will need a solution, that will be able to bring them the best. And the most relevant piece of content from the streams. – AMP 3, #00:00:42-4[24]

The quoted programmer refers to information overload as a challenge, more concretely as a technical challenge. He states that people always had to deal with information abundance, also now in the digital realm. In the understanding of the interviewed expert information overload is not a new problem, however, it is a problem that has become more severe in the digital realm. In particular, because the barries to producing and publishing content have become lower.

The quoted programmer refers to information overload as a challenge, more concretely as a technical challenge. He states that people have always had to deal with information abundance, and now also in the digital realm. In this expert's understanding, information overload is not a new problem but it is a problem that has become more severe in the digital realm, in particular because the barriers to producing and publishing content have become lower. At the end of the quotation above, the interviewee mentions that too much information is being pushed to the user. This is the most interesting part, because it shows the main technical development that algorithmic

24 Quotations used in this chapter have been edited for readability, however, their meaning has not been changed.

media is based on: RSS feeds. The abbreviation RSS stands for Really Simple Syndication and is used to automatically publish information once its created. By subscribing to RSS feeds, users found they could automatically receive information and no longer had to actively search for it or go to a news site. All the user had to do was open a mail program and the information was pushed to them. This might sound almost outdated nowadays but, at the time of invention, it was an absolute novelty. Subsequently, all information was published and pushed to the user, which resulted in a variety of information that was neither important nor relevant and possibly simply redundant. Even though it was seen as a great advance to receive all information instantly, it took a great amount of time and effort to shift through and decide whether it was relevant or not. It was in this context that the idea of creating an automatic system that identifies relevant information took shape.

This principle is also known by the more technical term of information aggregation. What aggregators do is automatically collect information from various sites, for example blogs, social media and other media outlets, and then present the collected information on a third website. Content aggregators take advantage of the fact that digital content is no longer strictly bound to its publishing medium and can thus be shared and published in various ways on different platforms. At first, aggregated information was presented chronologically. Later, as more people started to use such services, the question arose as to how to present the information in a more user friendly way, which meant displaying information the user was interested in. This is where personalization or, in other words, the customization of information towards users' interests, comes into play. Programmers started to work on an automatic solution that could efficiently identify information of relevance to the user.

To identify relevant information is a very complex matter from a technological point of view. One of the key issues in this regard, and one that has not yet been satisfactorily answered, is how machines interpret natural language correctly. Within human language, words and concepts are often used interchangeably. In addition, meaning is highly dependent on the context of the conversation and actions, such as listening, interpreting and asking further questions. All of these actions are no easy task for machines generally, and certainly not an algorithm. Programmers therefore needed to find other ways of identifying users' interests and this is why algorithms relate to their users through an analysis of user behavior. Analyzing a user's clicks and drawing conclusions based on their behavior seemed, from the creator's perspective, most reasonable.

This can be further substantiated with the following interview material, in which another programming expert describes their initial idea in very similar ways. As in the first example, their main ambition was to help users effectively navigate the digital information realm. In the interviewed expert's understanding, information is considered ineffective if the user cannot access the information in fast and convenient ways:

> And the idea is that you have some sort like personal aid, if you are a prime minister than someone reads the paper ahead of you and mark you the interesting stuff so the thing is that everybody could have such a help. So the application creates you a start page. It reads ahead of you the news ... the application which might be of interest to you and filter out only the relevant information and present it in a feed like page on your homepage. – AMP 1, #00:04:08-9

The programmer quoted above describes their idea of algorithmic technology as a personal assistant, someone or thing that helps find interesting and relevant information in advance. The main idea of helping users to find relevant information stands in stark contrast to the dominant public view of algorithms as invisible information censors. The citations above are therefore provoking because they show a very different perspective on algorithms: from a programmer's perspective, algorithms are understood and utilized as helpful tools; they are framed as specific services that are supposed to make information navigation easier. This programmer's perspective on algorithms is fundamentally different to how algorithms are publicly framed .

Another theme that emerged from the interviews, and one that is closely related to the idea of effective information navigation, is the issue of time management. This is an issue which, according to the interviewed programmers, is another major challenge in the digital realm. One of the interviewed experts talks in this regard about a concept he developed called frictionless sharing. His concept of frictionless sharing focuses specifically on the distribution of information with the goal of increasing information visibility through the automation of shares. His idea was to create an automatic process by which articles could be shared directly from a user's browser history to various locations on the web. However, after several user tests, the programming team discovered that information saved in the browser history is often very private and sensitive; most of the users tested wanted to keep control over what information was shared and what was not. An automated service thus appeared too intrusive.

After several more user tests and further development of the algorithms, the programming team came to the conclusion that sharing news articles was more feasible and less intrusive for users. Subsequent to the primary research, further tests were conducted and the programming team discovered that users spend a lot of time reading news from different sources. This led to the idea of creating an algorithm that combines various information sources and then displays a list of news that seems relevant to its user. In the interview, the programming expert stated that they

> wanted to see if it is possible to make a system where a person is a curator without realizing he is a curator. – AMP 7, #00:14:42-7

The notion that the person or user of the application does not realize that they are the curator could again result in resistance and could be seen as trying to manipulate information. In the interview, however, the programmer explained that his idea relates mainly to the easy manageability of data. He understands the underlying idea, the atomization of the process of finding relevant news, first and foremost as a technological endeavor. According to the interview material gathered, a product works best when the technological processes take place in the background. That is why their goal is that the person should not notice that he or she is the curator of information. Within public discourse, these ideas are mostly discussed and interpreted in the light of a lack of transparency or loss of control. The empirical material shows, however, that the interviewed programmers have quite a different perspective. In their understanding, extracting relevant information should be performed by an automated system that runs as efficiently as possible in the background.

The idea of a user-based automation of editorial tasks illustrates the strategic-functional goal behind algorithmic media, which is very distinct from traditional media. According to media theory, the traditional news media select news according to a set of news values, against which algorithms are often measured. Throughout the conducted interviews, there was no evidence that the programmers follow these ideas of news values. On the contrary, over and over again, the focal point of our interview became the user. The user and an analysis of their behavior is what algorithmic processes in algorithmic media are based on. To reiterate, according to the interviewed experts, it is the user that curates their news, with the help of algorithms. This again supports the view of algorithms as a service. The programming experts see themselves as experts creating service technology, which also shows in the next quote:

> So there is a device that tell us that there is new information; that connect the opportunity in the physical life with information that flow all around. So there is a knowledge system, something, that should help us to match content, real-time content, that is generated by many people, by systems, by anybody, that tries to match users need as they are right now. And that is a major shift from the way people consume content and how most people actually perceive the way we consume content today. – #AMP2, 00:00:08-6

The following quotation elaborates on the installation process and the functionality of algorithms in more detail and tackles questions such as "how do algorithms learn about their users in the first place?" and "how do they detect the user's needs and context?".

> Just install it, you don't choose anything, no areas, no topics, no sites, nothing and then after 15 minutes you got a page with your news and from this point on so once we build a profile[,] we have a profile this like a net and then all the data that we find relevant again we are doing smart selection of data automatically[.] [Y]ou don't need again to add feeds, ok this is a side I like, goes in this net and we catch the interesting fish, the one that capture all the net usually the metaphor either net or magnet no force gravity, like things falling and then gravity catch your interest and then you present it on the web. You get it on the start page and then we go on following what you do so when you're interested in new topics [shows examples of topics] so I start reading about it and then I start to get news about tracking. – AMP 1, #00:06:43-2

What the expert is describing is how the system generates an implicit user profile. Once the application is started, random information from different content providers is shown. Now the users starts reading. The algorithm then notes which information the user clicks on in the first place and therefore reasons that this information must be most important to the user. Unlike other services, in which users specify their interest by clicking on different categories, algorithmic processes draw solely on implicit feedback such as how long a user stays on a certain site and how they navigate through the displayed information. Another expert describes how their algorithms work as follows:

> If I give you a list and you read the 7th item. So I figure out this is the most, at least you saw the first six (...) maybe not the whole 10. So I can learn about your preferences (...) interest is also how long did you stay inside, how long did you read it. This also depends on the article itself. If it's tweet or an actual article. Of course the calculation of that is different. Also your preference, if you read the 7th item, it's not necessarily say anything about the others because if the first five it's about [mentions a topic] and you read about it and you hear about it in the radio and you don't [see the] point to read it anymore, you should be careful not to (...) you don't care about [mentions a topic] that is not necessarily said. So we are trying not to do an absolute decision, like you like this and you don't like this. Our model is we always give a rank, like you prefer this to this. It doesn't mean you don't like this. And it doesn't mean that tomorrow you have another mood or if you in work or if you are in the weekend and try and look for movie critiques so it's different. So it's very important to have the sensitivity. And not to be very strict or decisive that's why your learning scheme has to be flexible. Not like a

> tree, decision tree. If you like this go here, if not go here. This is not really working [in] this data world. – AMP 4, #00:16:40-0

This quotation highlights not only the functionality of algorithms but also makes a point with regard to the adaptability of algorithms. Algorithmic processes are constantly learning and adjusting. During the interview, the programmer showed a list of ten news items to me in order to explain how conclusions were drawn. As stated earlier, one of the most decisive factors it relates to which article the user clicks first. All the programmers I talked to interpreted the user's first click as a sign that this specific information was most relevant to the user at that specific point in time. If the user, for example, clicks on sport news first, it is assumed that sports is of the highest relevance at that specific moment. If a user clicks on the 7th item, as described in the citation, it is assumed that the first six items were not relevant and hence the content of those items is analyzed and prioritized lower in later rankings.

Once again, this shows the different basis on which producers of algorithmic media have built their service. All interviewees reiterated several times that their starting point is the user and what is relevant to the user – a strategic decision. If the user is not interested in political news, they do not believe it is their responsibility to generate interest in such topics. It is on this basis that software processes are modeled:

> Software is not really modeled in a way that you can sort of checkbox, like right wing stuff, Hollywood stuff, you know, it's more mathematical and when it dumbs down to a subject you can't really know what your writing will affect more, stuff like this or stuff like that. – AMP 5, #00:03:30-4

This fundamental difference to traditional news is the result of a scoring process. In mathematical terms, this means that every piece of information in algorithmic media receives a specific score and then the information with the highest score is ranked first. Information is not ranked according to topics or societal relevance but according to the internal scoring system based on user behavior.

> So we saw that let's say, you follow Ashton Kutcher, so we see what Ashton Kutcher has written in his bio and who he is and we say ok, all these various keywords, you might be interested in them. Like we never used to say she absolutely, she loves this. But what we did do was sort of compare how you interact with certain people to other people – AMP 5, #00:02:49-3

> It's based on a lot of assumptions. I mean we make an assumption that if a person read like 20 things, but he interacted with the 4th item, so we assume and there are a lot of assumptions, we assume that the 4th item was more interesting to him than the first, second and third one. So we assume that... you were more interested in the 4th item than the other ones because you didn't interact with them. Maybe you didn't retweet them, you didn't reply to them, stuff like that. So that's how we refer to information. – AMP 5, #00:04:52-5

In order to inquire into this procedure in more detail, it is helpful to take search engines as a reference point. Search engines are aimed at finding the most relevant match in relation to the given search query. The scoring system is thus used in relation to the search query. In the case of algorithmic media, however, there is no search query as a starting point and the user's behavior is therefore taken as the starting point. Another important factor is what is now referred to as system performance. In the example given above, in which a user clicks on the 7th news item in a list of ten, the system performance is considered rather poor and so the system will start adapting. It will analyze the information the user has clicked on and adjust accordingly. This adaptation process is called system learning and is described by the expert as follows:

> We wanted to learn the knowledge about the specific user and allow the learning to be unlimited. So that's the algorithm that we developed. It help us to learn, to develop knowledge about but any specific user, how we do that? We develop a mechanism that is called navigation graph. Ok. So we are watching people that want to use our service. They let us to watch their navigation using the content. Every time you show interest in the content, interest could mean that you stop, you open, you did something with the content, you share it, any activity around the corner you show interest, we take this information and we take the information around it. Actually the information that you decided not to pay attention to. And that is our input. – AMP 2, #00:35:44-6

> [W]e analyze any piece of content, that's another difference between us and a search engine, we analyze items, not pages. So a page could contain, many articles and we will break it to a specific article, item that has been defined by the one that created it, start an engine and we analyze every item like that and we'll describe it in our feature world and then when the user start to interact with the content, we'll learn what other content things, content items the user shows interest and what content item the user didn't show interest in. And feed that to our learning engine. In order to learn over all to develop a knowledge about his behavior, basically the attention he gave to specific content. – AMP 2, #00:42:18-0

Once system learning has taken place, complex mathematical formulae are used.

> A pair is if you read an article before another one, then this pair, like each item in the pair is this mathematical function that represents all of the words in the pair, in one item and maybe anything else that we could infer. So image like one item being just a news article and another item being another news article and this model would be this huge, huge list and then this is a very big simplification, because it's not really a list, it's more of a grid, an n-dimensional grid... but you can imagine there is a list of like, of like article one more interesting then article two. Article 416 more interesting then article 5... and then given a new item, we can sort of know its place and understand where it comes, before other stuff. But this is all translated to math and numbers and actual and each word get sort of like this mathematical value and then we get the new article and we sort of calculate its function and we know, we got this sort of value in this like huge grid and we know where it's placed and we know where everything else is placed, so we can sort that. – AMP 5, #00:09:19-5

The last three quotations show the idea behind algorithmic media and the functionality of algorithms as complex mechanisms. Algorithmic decision-making is a relative process in which scores are attributed to a piece of information and, based on this score, a list of ranked information is displayed.

In the section above, the functional-strategic dynamic has been described and substantiated with empirical material. The inquiry showed that algorithmic media first began mainly to solve the problem of information overload. According to the material, the concept of information overload refers to the amount of available information as well as its efficient access. According to the interviewed programmers, user studies showed that many lacked orientation when navigating through digital content and hence the idea of creating an automatic procedure took shape. The material further showed that programmers view their algorithms as services. This stands in stark contrast to the general understanding of algorithms. The interviewed programmers describe algorithms, and more specifically algorithmic media, as a service that helps users to find information that is relevant to them. This shows once again that the concept of information relevance in algorithmic media relates specifically to the user's interests, in other words the information a user clicks on and spends time with. This raises the wider issue of information accountability. If algorithms are oriented towards user behavior, what are the possible consequences and implications for the average user? These questions will be dicussed in the following chapter 6.

In the last part of the section, the process of information ranking was further explored. It could be seen that ranking takes place in mathematical grids. Information is weighted against itself and receives points. This process takes place continuously in multiple dimensions and is therefore highly complex and cannot be expressed in simple decision trees. In summary, the strategic-functional dynamic refers to the goals behind the service as well as the complex mathematical processes of information ranking.

### 5.2 Narrative dynamic

The (2) second dynamic that emerged throughout the analysis has been termed 'narrative dynamic'. This dynamic refers to the concepts used to describe and talk about algorithmic processes. Throughout the interviews it became apparent that programmers', journalists' and users' understanding of the different concepts describing algorithmic media differs greatly. This is an important finding because discussions in regards to algorithmic media revolve around the same terms, but they are understood, defined and interpreted very differently. How this dynamic plays out will be shown in more detail in the following analysis, in which statements from the different perspectives of the interviewed programmers, users and journalists will be explained, discussed and juxtaposed.

In the first quotation, the interviewee talks about the concept of determinism in relation to algorithmic media and computer programming. A common question that is often publicly discussed is whether algorithms are deterministic or not. This question relates to the broader discussion of how algorithms affect digital information flows and the visibility of news. Generally, the interviewed programmers reacted critically towards the idea of deterministic algorithms. One of the interviewed programmers stated:

> No, it's definitely not like that. Determinism is one of the base concepts in computer science and there are a whole family of algorithms which are not deterministic. They never, they might not give the same result for the same input. It's a well known thing, you learn it at the first year of school. And all of these like machine learning, artificial intelligence, stuff like that, those are not deterministic, not at all. I mean by definition they are all based on estimations, they all have like this random factor in it, there is serendipity, if you write it properly. – AMP 5, #00:13:10-6

In this quotation the interviewed programmer rejects the idea that the algorithms they have developed are deterministic. He supports his argument with an explanation of what the concept of determinism entails from a computer science perspective. He explains that the concept of determinism is very basic, even outdated. He continues by giving the example that the same input might not lead to the same output, he calls this a non-deterministic algorithm, meaning the same input variables could generate very different outcomes.

By comparison, the interviewed users understand the concept of determinism quite differently. For them, the concept of determinism stands for algorithmic decision making, which eventually influences the information they get to see. From a user perspective, it is often assumed that the algorithms decide whether the user receives a specific piece of information or not. Based on this idea of algorithmic determinism, it is then concluded that information visibility solely depends on algorithmic performance. The following quote, made by a user of algorithmic media, shows and outlines this understanding of algorithmic determinism in more detail:

> Yes, of course. And so I have a lot of times thought about that. And we have also in the radio we have spoken several times about that. I mean but not only in Twitter or Facebook or that. I am very upset about what Google is doing. And think in that: okay, they want to personalize our information. They want taking into account the information we give them. The click we do. The things we see. Everything we do. They give personalized information but I wonder that if we are not getting more short minded. I don`t know you understand with that because everything we are getting is something with that someone else thinks it`s good for us. I don`t know if I can make me understood. I mean, really, we don`t choose what we see. Someone else chooses for us. And that is very worrying because I have got students and I am very interested in that point. – AMU 5, #00:11:14-6

A key idea in this quotation is that of being unable to influence information visibility. The user expresses his concerns in relation to what he[25] understands as algorithmic decision making. More concretely, he is worried about the fact that people might become narrow-minded due to the increased personalization of information, which in his view may lead to users not being adequately exposed to important information. He goes on to refer to his own Facebook and Twitter use, and continues to speak about the implications of personalization. He ends by concluding that the information he receives is chosen by someone other than himself or experts, which from his perspective is a negative idea.

Throughout the interviews this ambiguity around determinism was mentioned several times: On the one hand, the interviewed users were aware of personalization effects, and the idea that these are based on their click behavior, but on the other hand it seems they believe the information they receive is fully chosen by algorithms. A little later in the interview, the same interviewee formulates the issue more pointedly:

25 In this whole chapter the pronoun "he" stands for the user, it is in no relation to the gender of the interviewee and/or user.

> I think we are manipulated. – AMU 5, #00:12:45-8#

The idea of being manipulated through algorithmic processes resonates with a number of users. Many of them have the impression that they receive unbalanced, biased information through algorithms and algorithmic media. However, programmers developing such algorithms see this matter very differently. One of the interviewed experts questioned the understanding of algorithms as decision makers; in his view, algorithms solely rank information:

> It doesn't make decisions. It gives rank for things. So it's like mathematical formula. You give the number inside and the formula gives you a rank. And this formula of course is changing all the time. Whatever action you do. – AMP 4, #00:19:01-1

The citation underlines yet again the very different – partially opposing – perspective of programmers on algorithms. According to them algorithms do not make decisions; as stated, what they do is rank information on the basis of mathematical calculations. Furthermore, the programmer states that the employed mathematical formula is constantly developing and changes constantly. From a user as well as a societal perspective this is difficult to conceptualize, especially in terms of this ever-changing mathematical formula in regulatory frameworks.

Another concept that is often used to describe algorithms is that of algorithms as filter mechanisms. Questioned on this concept, the same programmer from the quotation above states:

> We don't filter out. We only sort it. (...) Filtering is not very clever. I mean it's like if you have information overload and you just drop sources so you didn't really solve the problem I mean you just ... yeah, you solve the problem but not very wise. You just give up about an information. So we do something else. So I think it's the correct way to do it. We are giving the user the ability to be the editor. It's not exact of course. AMP 4, #00:09:17-3

What the programmer talks about in the quotation is how information is systematized. The interviewed programmer compares the mechanism of filtering with dropping sources, which in his perspective does not solve the problem of information overload. Therefore, he talks about sorting information and by sorting he means that information is ranked according to a specific system, which influences where information becomes visible. He explains that the algorithms he is working on sort information and work on the idea that users become their own editor. An important point in this quotation is the notion of problem solving. As described earlier, the development of algorithmic media came about as a solution to the abundance of digital information, hence algorithmic media seeks to offer a reduction of information, with the aim of displaying only relevant information. This highlights once again the very different premises in the on-going discussions around algorithmic media. While programmers focus on a customer perspective, users mostly use and understand algorithmic media in a normative framework.

Another interviewee, who is academically involved in the field of algorithms, formulates the issue more positively by stating that algorithms ensure the visibility of information that is relevant to the user:

> But in some sense you could also say that it's filtering and it's sort of making sure that I see things that I'm interested in and perhaps that's a good thing for news.
> – AS 1, #00:12:44-4

This interviewee offers a convincing argument for using algorithmic media. In this understanding the use of algorithms ensures that the user does not miss out on information he or she is interested in. What the previous two citations show is a tension between a service perspective, primarily employed by the programmers, and a normative perspective that focusses more generally on the content of information; this tension is one of the dominant narratives that can be found when analyzing the interviews.

Building on this finding, the next section will present and discuss further interview material that responds to this analysis from different perspectives. The following quotation sheds light on the human factor within algorithmic media:

> [I]think you're very much the human actor who are making the decisions what content goes out there and content gets shared. The fact that the technology fulfill a level of mediation shouldn't be allowed to hide the fact that it's still humans who are making the individual level of choice. So I don't view we're completely dominated by the technology but I do think that we are completely dominated by a fetishism of technological influences. – AMU 8, #00:08:56-2

This user conceptualizes algorithms as a form of mediation. He describes technology as a layer that is made and used by humans. He ends his description with the claim that at the moment the dominating narrative is what he calls the 'fetishism of technology'. In the context of the gathered interview material this can be interpreted as that the possibilities of technology are overemphasized. The interviewee states that it is humans that create technology and it is humans that use technology. This social-constructivist argument is a common view on technology. What it entails is the argument that the influence of technology as a tool may be overestimated. Elaborating on this, the following interview sequence between myself and a programmer relates to the concept of control with and through technology:

> The problem is, that somebody always controls what's important in the world.
>
> I: With personalization, who controls then? #00:16:19-4
>
> Nobody. […] I can't control the random parts, that is obvious and I can't control the community parts, because that's controlled by the community itself, I mean a lot of people read it, as a higher rank, I give it to other people as well. I can only control the distribution. […] From a scientific point of view I think I wouldn't want any control on the programmers end. I would try to bring it to a point the system would level itself out constantly. AMP 5, #00:16:24-2

This short interview sequence discusses the concept of control in relation to personalization technology in greater detail. The programmer starts by explaining that somebody always controls what is important in this world. This explanation is related to a longer interview sequence, in which the nature of digital information flows were discussed. Building on this line of thought, the programmer stated that he believed that there will always be somebody who controls the important information in the world. Being critical towards this argument, I subsequently asked the programmer "who exercises control when personalization technology is employed?". In response to this question, the programmer elaborated, taking the system they created as an example. He states that he as the individual programmer does not have control over digital information flows, because they highly depend on the summed user behavior. He refers specifically to the community behavior and that ideally the system would balance itself out.

The programmer's thoughts refer once again to the idea of algorithms as complex systems, designed to function autonomously. Creating autonomous, or 'technically controlled', systems is one of the common goals in the software industry. This idea also unites the programmers of algorithmic media. As stated above, it is their declared goal to create algorithms that analyze the user's individual behavior. Following this, I then asked about the reliability of digital systems:

> I: So you believe more in a system that is also build by programmers at some point, then in humans?
>
> P: Yes. Because humans are idiots.
>
> – AMP 5, #00:21:04-5

"Because humans are idiots" is a powerful statement and it is important to leave this statement in the context of the interview, where it is related to the question of why he as a programmer favors technological systems over human systems. In this regard he has a clear opinion, namely that technological systems are more reliable and predictable. Relating to this, another programmer points out that this might be an intimidating idea.

> Maybe it's not so nice to hear that the computer can understand your preference, or if we are doing a good job or it's not you to decide. – AMP4, #00:20:02-9

In public debates the narrative of computers understanding or even predicting human behavior appears repeatedly. This is one of the greatest fears that is connected to algorithmic media; that computational systems become so advanced that they can easily manipulate humans. This is one of the reasons the dynamic I describe here is called narrative dynamic. As mentioned earlier, throughout the interviews it became increasingly apparent how differently algorithms are described. Often, precise concepts are missing, and algorithms are described rather vaguely, with technical details lacking. Furthermore, technology is often described as advanced and difficult to understand as also the following quote describes:

> The whole machine learning concept it's a bit more sexy for a programmer. It utilizes a lot of more advanced stuff in computer science, stuff that PhDs are doing […] to me it was just like a pure learning experience ... it was very fun. – AMP 5, #00:11:35-6

It sounds as though the programmer does not believe that his profession is very accessible to the general public, to describe this belief he uses the term 'sexy' – 'it's a bit more sexy for a programmer'. In the interview, he says that the programming part of the application might be more appealing to other experts in the field than to the general population. Going deeper into the analysis of what types of concepts and narratives are employed, the following quotation illustrates very well how algorithms are currently perceived and in part how programmers may want them to be perceived.

> So we started to look for technology, that will help us to develop a solution, that meet this magic. You can call it the magical mechanism, that the user actually do not need to explicitly say what he wants and still will get very good results in the quality of content, that really matches the needs right now. So we looked for a technology, that will help us to do that. – AMP 2, #00:22:22-3

A little later during the interview the programmer stated rather pointedly:

> It's looks like magic, right? We have the ability to predict user behavior with content and you don't really, you don't know [how] it works around you. – AMP 2, #00:57:15-3

Taking this statement literally, one could believe that the prediction of user behavior is actually possible. However, as the statement earlier describes, mass behavior is hard to predict. Especially if one takes human irrationality into account. Even though there exist several conceptions of the predictability of human behavior, becoming conscious of one's own behavior still opens up the opportunity to act differently than the system expects. However, this discussion is very much a case of the chicken and egg, and which came first. Does the system adopts itself to human behavior or the other way around? An important learning in this is to take a look at how technology is talked about and conceptualized. If a programmer states, as above, 'it looks like magic' and 'we can predict human behavior' these statements are often taken for granted and believed to be true. However, contrasted with other similar statements, it appears that this is more a narrative revolving around algorithmic technology than an actual description of algorithmic technology. This can also be seen in the next quote taken from a written interview:

> The goal of the semantic analysis system is to create knowledge that we can use for personalization, based on the content we gather. It is unbiased, smart, powerful and scalable technology. – AMP 6, written interview

In this interview the concept of unbiased, smart, powerful and scalable data is raised, which is rather questionable. It seems more like a general marketing description than an actual description of the technology behind algorithmic media.

In the following, I will present some quotes that describe the intention of algorithmic technology using more accurate concepts. The next quotation describes algorithmic media with the understanding of users being their own editors. Describing algorithms as editors may sound softer than as shown in earlier quotes, where algorithms have been described as filter mechanism or decisions makers.

> Our job is letting the people to be their own editors. We don't change the content, because if the person take the newspaper and read only the sport magazine and throw the other things and there are many people like this, so we don't think it's unethical. It's a freedom to read whatever he wants. We just try to help doing it. That he won't have to buy the whole newspaper. Only the sports stuff. On one side. – AMP 4, #00:06:50-4

Again, the algorithmic service is described as a helping tool to the user. The interviewed programmer draws on the example of buying and reading a newspaper. He describes that the user might not read the whole newspaper but is only interested in the sport sections. He claims this is the behaviour the programmers of algorithmic media support, namely the specific interest of the user. While this might be uncontested in relation to sport news, it is rather contested when it comes to public and political opinion. Later in the interview, the same programmer formulates more pointedly:

> It's all about freedom - freedom for the user. – AMP 4, #00:49:37-9

Looking at these two statements together, the narrative of algorithmic media becomes clearer. It is about the individual user's freedom and at the same time about convenience. One point is the user's individual freedom and that he or she should be entitled to their own choices; this understanding entails rather liberal values. What algorithmic technology does is amplify these pre-set interests – a phenomenon which is often also described with the concept of the filter bubble. This concept entails the idea that algorithms present selective rather than one-sided information. However, from a user perspective this might be put too simply as this interviewee describes:

> Sometimes filter bubbles doesn't explain things enough. We lose nuances in between: this continuum of International newspapers' view and all these alternative websites, that I follow. – AMU 8, #00:04:02-4

This user describes his own information seeking behavior and states that in addition to algorithmic media he seeks information from other sources. Even if the filter bubble concept proves true for algorithmic media, this does not mean that the user is locked into it, because they still have the option to receive news from other news sources. Hence, in order to understand the impact of algorithmic media on the individual user, it is important to take a holistic look at the user's specific information behaviors.

Going back to how the producers of algorithmic media describe their products, another media producer describes their service using the concept of easiness.

> Our company's main profile is to make things easier. To do things that people already can be done easily. […] To create new ways of translating old ways of doing things easily. For example buying products more easy or having routines [that] become more easy to do. – MP1, #00:10:03-3

In this quote the interviewee describes the company aims: translating daily routines into technological processes. What they are specifically looking at is how repetitive routine processes can be translated into technological processes. Users' appreciation of this is illustrated by the next quotation. In this, the user describes his motivation to use algorithmic services.

> I wanted to see things in my immediate interest. I didn't want to beat around the bush too much, there's not a lot of time, so that's why I use applications and websites like that. Just so I could jump on very quickly, when I had a moment. – AMU3, #00:06:20-4

This user's priority is speed and convenience, which relates back to the concept of easiness, discussed above. This concept of easiness is supported by another user, who believes that more and more people will use such services because they are time efficient and may help someone to receive more of the information they are interested in.

> I think more people are going to be trying. Just because people don't like wasting time. I don't want to have to take a music course when I'm going to school

> to study chemistry... It's the same thing with news. [. . .] We're moving towards ... people are only spending time on content that they really care to spend time with. – AMU3, #00:09:36-1

Again, this idea is supported by the producers of algorithmic media. Here the concept of relevance comes into play again. The programmer involved in the creation process of algorithmic media aims to develop a system that does not create filter bubbles but still gives visibility to what is relevant to each of the users.

> [We] have to develop some kind of system of making sure that the stuff that people read would be relevant to each other, without creating a huge filter bubble again. – AMP 7, #00:26:29-7

Another programmer describes this same issue through the idea of user needs – that users have different needs, which need to be taken into account – which also show the next quotation;

> To users, it's a way to find great content and spend less time filtering through useless junk. – AMP 6, written interview

However, not only the user is involved but also the creator of the technology. Here the concept of helping is expanded to them as well.

> It will help both sides. The consumer will get the relevant content and the producers of the content will be happy, because the consumers that are most relevant to this content actually will be on the top. The probability they consume the content will be much higher. So we believe that we help both sides. – AMP 2, #00:46:10-3

In summary, the aim of the description of what has been termed the narrative dynamic was to explore algorithmic media in greater detail through the concepts used to describe and explain the technological processes. It could be shown that that the different interviewees, especially in their different positions, have a very different understanding of what certain concepts and explanations entail. As stated at the start, this is an important finding insofar as it highlights the rather uncertain knowledge revolving around algorithmic media. Specifically, the previous section has looked into the concepts of determinism, manipulation, decision-making, filtering, control and prediction in relation to algorithms. Further, the idea of filter bubbles and algorithmic media as editors have been discussed.

### 5.3 Knowledge-awareness dynamic

The knowledge-awareness dynamic is the (3) third dynamic identified during the process of data analysis. Knowledge-awareness refers to the knowledge and awareness, or lack thereof, of one's own behavior in relation to algorithmic media, and resulting possibilities to act. The latter is strongly related to the fourth dynamic, which is termed 'action dynamic'. As already described, algorithms analyze user behavior. Hence, one of the crucial and often underestimated factors is the user behavior itself. When users are asked about their behavior with algorithmic media, they can rarely put their experiences into words easily. A major reason for this the highly rountinzed and habitualized nature of this behavior. One of the interviewed programmers summarizes the issue as follows:

> It's actually you can not describe what you really want. (...) Your action describes it. (...) But if you will be asked to describe yourself, you will not do that very well. From the fact that you actually do not know yourself – AMP 2, #00:35:44-6

This citation addresses the essence of the knowledge-awareness dynamic, which is located between conscious and unconscious behavior. Conscious behavior marks behavior that is consciously decided upon, for example to open a specific program or to use a specific application. Unconscious behavior refers to behavior that is habitual and routinzed. In relation to algorithmic media, this behavior is less traceable and often harder to determine. Examples are how much time has been spent on a specific page or how many articles were scrolled through before the user clicked on a specific item. It is especially the unconscious behavior that programmers try to utilize and work with as the citation above shows. The programmer states that users can often not describe what they want, however, their behavior may show what they are interested in. Hence, it is the click of a user that is recorded and taken into account. In the following, another programmer describes how user behavior is automatically followed in greater detail:

> So what we do is we follow your browsing history we again the application not the company something local that runs on your computer and build a user profile. This profile is what we call the mini topics, small high regularity topic of interest in reading […] it's a really very narrow topic, it won't be sports or politics, it could be the if it's sports the specific team that you like or with politics the specific story that now you are following and you find it interesting, the singer that you like, out of tech which company really interest you or what kind of technology really interests you and so the system builds the profile very detailed profile, completely automatically and the user doesn't have to select anything, doesn't have to choose anything, just install. – AMP 1, #00:05:27-8

In this citation the interviewed programmer describes the procedure of how a user profile is built and how some information becomes visible and other information does not. In this specific example, the locally installed algorithmic media application extracts information from a user's browsing history. The programmer describes the individual steps of the process as follows: First the user needs to install the application on the computer. This is done so the user data is secured on the user's computer and is not accessible elsewhere. The second step is to analyze behavioral data. Therefore, data on the client's computer such as the browsing history is extracted, evaluated and analyzed according to its content, and based on this a user profile is created. The created user profile is then used to find relevant information that the user may be interested in in the future. The programmer explains that topics which enter the user profile are very specific, and not comparable with newspaper categories. In the quotation, the programmer mentions the example of sports. When algorithms analyze, they analyze in relation to a very specific concept or term, for example a specific team name. Algorithms do not operate in human terms and analyze in broad categories such as sport.

From a machine learning perspective, the concept of sport is too unspecific and will not lead to valuable results.

An important point made in the quotation is that the user profile is built completely automatically according to the criteria described above. This means that once the installation process of the application is completed, the process of data analysis takes place. As described above, in this specific case it is the browser history that is used as a data basis. Algorithms analyze the data in the browsing history, make assumptions on that type of data, and create the user profile. Once recurring patterns can be found, e.g. the same team name appears several times, the assumption is made that the user is interested in this specific team. If in the future this team name is detected, that information is made visible in the application. In this context, it is important to note that the process is iterative. This means that algorithms constantly update their user profile. The procedure in itself is rather simple, though often unknown to the user because the technological specifics remain intransparent.

During the installation process itself there is no notification, that the browsing history serves as a basis for future news. Once again, this demonstrates the relevance of the knowledge-awareness dynamic, which focusses on the knowledge, or lack thereof, in relation to algorithmic processes. By contrast, the following quotation sheds light on the issue from a user perspective. In the quotation, the interviewed user explains why he uses algorithmic media. He does so because, in his opinion, algorithmic media shows what he calls omitted views; views that according to him often do not receive attention from public media.

> The perspective that I tend to disagree with is the perspective that is in the national newspapers lately. It's the omitted views that I consciously go and looked for. So that's what I do with my media. [There is] a lot of activism that don't get highlighted in the newspapers. Increasingly the newspapers can be irrelevant to me. You know, I have a developing sense of what it means be an active and engaged citizen. – AMU 8, #00:01:43-7

In this quotation, the user offers an engaging view on algorithmic media, a view that is connected to gathering specific news the user is interested in. Specifically, he states that national newspapers may not provide the views he is interested in. Hence, he decided to use algorithmic media because these services help him to get information that might not be available to him otherwise. The interviewed user calls these views 'omitted news', in other words that is information he is interested in but can not be found in publicly accessible news. This is an interesting viewpoint because algorithmic media is strongly critized for showing one-sided information, which also relates to user behavior as the next citation shows.

> You get it on the start page and then we go on following what you do so when you're interested in new topics .... so I start reading about it and then I start to get news about tracking. – AMP 1, #00:06:43-2

This citation is a continuation of the the earlier quotation, which described how a user's browsing history forms the basis of future news. In this quotation the programmer uses the term 'following' in order to explain how the visibility of information arises. According to the interviewed programmer, following means analyzing the user's behavior, more specifically the click behavior and furthermore analyzing the content of the information. This means prominent and repeating words are extracted from the information being read. In this quotation, the programmer explains the procedure using the example of tracking. If a user is interested in the topic of tracking and starts reading about it, the algorithm detects this by the method of word count. If, for example, the word tracking is used repeatedly, it is analyzed as an important concept. The concept is then an indicator of a user's interest and further articles based on the same and related terms are granted visibility.

Another important point in relation to the knowledge-awareness dynamic is the social relation between different users, and the assumption that the information one reader is interested in is also relevant to someone else. In the next quotation this is called a 'social reader'. While the name social reader is not used publicly and is rather a description used in expert concept, it does explain the connection between a piece of information, its specific reader, and wider social relations. The basic assumption is that if one user is interested in a certain piece of information, his social relations might be also interested in it.

> I think the biggest change has started in 2011 when Facebook essentially launched something very similar like we were doing, which was Facebook Social Reader. When I visited a news article or something like that, it comes to other people's feed. So I think, we and Facebook have had similar kind of ideas ... But I always feel that they did it in the wrong way and they didn't take into account that when you're automate sharing ... that's something really, really delicate for the user, because it's quite easy to have the feeling of losing control of what you share. – AMP 7, #00:06:01-7

In the quotation the interviewed programmer compares the functionality of the social media site Facebook with how their algorithmic service shares information amongst social relations. The programmer uses the term 'social reader'; a term that describes the routine of automatically sharing articles amongst a user's social relations. One of the key issues with this is that the user loses control, because he may have no or only little influence over which information is shared. That processes are being automatized without the user knowing it is another important point in the knowledge-awareness dynamic. After having described how user behavior is followed and automatically analyzed in general, in the following I will examine related issues in greater detail. One of them is the blurred boundary between content producer and user. The following citation begins with the statement that now, everybody is a content producer. In this respect it is important to note that content is not only content in a traditional sense of the word, but content is any information that can be used. A click by a user is for example also content production. The user may not produce content as such, but the user produces information about himself and his preferences.

> But now there is actually anyone of us content producers or even though what we'll do might be just forward of stuff by like or any other mechanism the systems give us. But we all produce content or help to popular content and people are actually following us or consume content by making only one decision, who are the content sources. (...) [before] there was people that consume and organizations that were content producers. Now it moved to everybody, so we are talking about billions of entities that produce content. – AMP 2, #00:00:08-6

In the quotation above, the programmer describes an ongoing development that, especially in relation to algorithmic media, has been receiving more and more attention. Here, the key takeout is that everyone has become a content producer, because everyone leaves digital traces. Traditionally, content production is related to educated experts, but with the rise of algorithmic media, the notion of content needs a re-conceptualization. What is new is that behavior is also content now. Clicking a 'like' button has become valuable content that is used to generate knowledge about a user. Algorithmic media has made a decisive contribution to this major shift from organizations as knowledge producers, and users as consumers, to everybody being a content producer, and redefining the basic concept of content.

What is very specific to algorithmic media is the factor of time. In the next quotation the programmer explains that they also take into account how much time a user spends on a specific page or piece of information. For the programmers of algorithmic media, the concept of time is another important point of reference.

> We actually took a look on how much time people had been spending on the site, which turned out to be a very powerful filter of the sort of daily news and daily mail. – AMP 7, #00:07:04-2

The time a user spends on a page or specific article is the basis for what is called 'attention graph' in the following. When estimating which information is relevant to a user, the component of time may provide several clues. A starting point for this is what the interviewed programmer calls 'attention graph'. This relates to the idea that online there is a competition for attention, because generally the user has access to more information that he can ever read. Therefore, it is important to find relevant information, and in order to retrieve such information time is taken as an indicator. In fact, it is assumed that the more time a user spends on the piece of information, the more important it is. That fact that there may be many other reasons why a user reads an article is of less importance to the programmer.

> Then we further developed a sort of attention graph. How much time people have been spending on more or less each line of text, which gave us the tool to understand, sort of the experience or subjective value ... or subjective quality of an article. – AMP 7, #00:08:22-0

The citation shows that technologically it may even be possible to analyze the time down to the line of text, – a very specific measurement – which has not been used as such before. This is another specific of algorithmic media – that basically every available piece of information in relation to click behavior feeds into the calculation. This is also shown in the next quotation, which compares the executed mathematical calculation to a secret recipe. The programmer states that even though all the ingredients are known, it is still hard to predict which information receives visibility as the amount in the ingredients are still an unknown factor. This citation also relates to the second dynamic; the narrative dynamic. Again, here the narrative is created that there is a certain secrecy around the functionality of algorithmic media.

> The recommendation algorithm, which means a sort of secret recipe for the recommendations. Or a few secret recipes. I've told you the ingredients, but I haven't told you how much of each ingredient you should put, and that's something that we have looked at. – AMP 7, #00:35:03-4

Aside from the notion of secrecy, the interesting aspect to this quotation is the idea of how personalization is created. The following interview sequence from an algorithmic expert, who works with algorithms in a university context, will shed some more light on this matter.

In the following, I will present three consecutive quotations from the same expert. The first addresses the relationship between the nature of the algorithm and the number of factors that are incorporated. The expert describes this with the example of a simple algorithm. In the second quotation the expert states that if more parameters are taken into account the nature of the algorithm is still the same, however, it gets more complex. In the third and final quotation a connection to personalization is created, which then explains why the number of factors is of such great importance in relation to algorithmic media. The expert states that a high number of factors that feed into the calculating algorithm eventually leads to the opportunity to personalize information in a better way.

> So, I mean, it doesn't matter, to me at least, how complicated you make these algorithms. I mean, this very simple algorithm I just explained to you, namely, I'll take your gender and birthday into account. That's the only two parameters. – AS 1, part 3, #00:03:44-+

> So I take two numbers into account, or whether I take two million numbers into account, that doesn't I mean, it doesn't change the argument whether I mean what kind of algorithm it is. – AS 1, part 3, #00:04:04-7

> If I take two million numbers into account, then it makes it much harder, I mean, in some sense that would give a better algorithm, because it would be more personalized. – AS 1, part 3, #00:04:22-6

An important takeaway from these citations is the connection between the individual factors that feed into the algorithm and the degree of personalization. Hence, the optimal performance of algorithmic media depends on recording as many factors as possible. Above, the factors of click behavior, time span, and social relations have been explored in greater detail.

That some algorithms can be much simpler is show by the next quotation. The producers of the algorithmic service states that they did not have the possibility of testing different factors, which they refer to as attributes. Therefore, they have created assumptions about what people might like, and, based on this, have created what they call 'relative feedback'.

> [W]e were kind of low on research, on resources. So we couldn't really, there is like a technique you could like employ to test various attributes and see what gives you a better score. But we didn't really have resources for that. So we made assumptions based on just our intelligence. We just decided ... I mean the original premise for the algorithm ... was what we call relative feedback. – AMP5, #00:06:17-7

This quotation shows the starting point of algorithmic media. As described, algorithmic media depends on data about user behavior. However, the starting point is still a simple model or theory to provides the very basic assumptions, which will be refined over time. What the programmer calls relative feedback is, in practice, a list of information that is evaluated against itself. How this is done is explained in more detail in the following:

> And it worked in a way that we know that we gave you a list, ordered from 1 to 10. But you read, actually you clicked on item number 3 first. We inferred that you prefer the content of number 3 to number 1 and 2. And that gives us this next time, if we get any content that is very similar to one and two and content that is similar to 3, then we can assume that because you preferred it last time, you might prefer it this time and we'll put it first. But if now again you choose the third item, then it switches back. That's why it keeps sort of what's going on. If I give you old news at the top and it's not interesting to you anymore, you gonna read the Johnny Depp item, then we know ok, she prefers that always and it's always before other stuff. That's how the only idea works behind it. – AMP 5, #00:06:46-0

In the quotation above the programmer explains how their algorithmic model works, a model which they call 'relative feedback'. What their algorithm does is distribute points to the individual pieces of information. Then in a second step, and according to how the user reacts to this list, a new list with relevant information is generated. While this procedure takes place iteratively, a level of information about users' preferences based on click behavior is gathered. In the example given in the quotation, there is assumed a list of ten items. The most important measurement in this case is which item the user clicks on first. It is assumed that this item, in other words piece of information, is most important to the user and hence, it is analyzed for its constituents and in relation to the other given pieces of information. Next time a similar piece of information is given, this time placed at the top of the list. From a mathematical perspective, this means that information with similar content receives a higher score and is therefore ranked higher in the future. Assuming the piece of information clicked on first was related to Johnny Depp, the proceeding information related to Johnny Depp will be ranked higher than other information. If the user now keeps on clicking on information relating to Johnny Depp the feed will show even more information about this. This iterative process continues until a change of behavior takes place and the user starts clicking on other news items. While this description might be simplified, it does illustrate the basic principle of algorithmic media, and why the component of the knowledge-awareness dynamic is crucial. If the user is aware of his behavior, and knows about the underlying procedure, the possibility of influencing the information feed increases.

Taking all the described factors into account, a more detailed image of how algorithmic media works can be obtained, which is summed up by the next two quotations:

> We are tracking the user behavior. [...] And basically we have interest in the order they read things. That's the main thing we learn ... – AMP 4, #00:16:10-6

> The order. If I give you a list and you read the 7th item. So I figure out this is the most, at least you saw the first six ... maybe not the whole 10. So I can learn about your preferences ... interest is also how long did you stay inside, how long did you read it. This also depend on the article itself. If it's tweet or an actual article. Of course the calculation of that is different. Also your preference, if you read the 7th item, it's not necessarily say anything about the others. [...] So we are trying not to do an absolute decision, like you like this and you don't like this. Our model is we always give a rank, like you prefer this to this. It doesn't mean you don't like this. And it doesn't mean that tomorrow you have another mood or if you in work ... or if you are in the weekend and try and look for movie critiques so it's different.

> So it's very important to have the sensitivity. And not to be very strict or decisive ... that's why your learning scheme has to be flexible. Not like a tree, decision tree. If you like this go here, if not go here. This is not really working and this data world. – AMP 4, #00:16:40-0

In the previous section, I have described in more detail what has been termed 'knowledge-awareness dynamic', the core of which being the user behavior. This behaviour may take place consciously, but it is often rountinzed and habitualized. The last two quotations sum up why this is of great importance. What the producers of algorithmic media do is to track user behavior. While at a first glance this might seem undesirable, at a second it opens up the possibility for the user to act upon that knowledge. Through the various interview quotations it has been shown that factors such as browsing history, social relations, time spent on reading an article, create content in different ways and this relative feedback plays an important role. Once users have more awareness of these factors, they have the possibility of acting upon it.

### 5.4 Action dynamic

The final and fourth (4) identified dynamic has been termed action dynamic. At its core, it addresses the question of how users approach algorithms, in other words what action they take and their awareness of action possibilities. The action dynamic thus refers, from a user perspective, to the user's action possibilities and, from a programer's perspective, to the framework they create for the user to manoeuvre in. The dynamic furthermore relates to the question of how users deal with and relate to the constant changes in and developments of algorithmic services and what approaches they have developed to navigate in and with algorithmic media. In the following, I will discuss the interview material with a particular focus on the issues mentioned above.

The first citation that I will discuss points to the solutional nature of algorithmic media. The programmer explains that they wanted to create a solution that matches the actual user's needs and, by extension, the user's actions:

> We started to look for technology, that will help us to develop a solution, that meet this magic. You can call it the magical mechanism, that the user actually do not need to explicitly say what he wants and still will get very good results in the quality of content, that really matches the needs right now. – AMP 2, #00:22:22-3

In the citation, the programmer talks of their intention when initially designing the algorithmic service. They wanted to create a service in which the user does not have to explicitly state their particular interests. One of the reasons for this is the programmer's assumption that users may not be able to explicitly state their interests and so it could be useful to find other ways of detecting a user's interests. In the citation, the programmer calls their idea to automatically detect a user's interest "magic", which is a specific way of framing algorithms (see also section 5.3). He further talks about how this magic, or algorithmic procedures, can learn about the user's interests without explicit feedback from the user. In relation to the identified action dynamic, the citation offers two opposing interpretations. On the one hand, the programer's statement could be understood as meaning that the service creates numerous possibilities for the user to act freely and, based on this, the user receives information. On the other, the citation could be interpreted as suggesting that the service creates insecurity. It could create insecurity because it is unclear which of the user's actions count towards information relevance in algorithmic media.

In the next citation, the identified action dynamic is described in terms of reading ahead. The programmer describes the system's algorithmic operation mode as reading ahead of the user. This means that algorithms analyze information even prior to the user's action. They do this by analyzing information that is saved in cookies, for example.

> So the application creates you a start page (...) It reads ahead of you the news... the application which might be of interest to you and filter out only the relevant information and present it in a feed like page on your homepage. – AMP 1, #00:04:08-9

During the interview, the programmer went through the installation procedure and explained what the user has to do and what the algorithmic media service does. The user has to follow a simple software installation process. Thereafter, the user's data is automatically analyzed and information shown based on the user profile created. The programmer describes the procedure as follows:

> Just install it you don't choose anything, no areas, no topics, no sites, nothing and then after 15 minutes you got a page with your news and from this point on so once we build a profile we have a profile. – AMP 1, #00:06:43-2

In the citation above, the programmer talks of how easy it is to use their software. He describes the installation process and explains the specific feature of their service, which is that information is automatically detected and analyzed. He describes this as a service feature; the user does not have to explicitly choose fields of interest but is analyzed through their prior actions, which can be traced in the locally-stored data. The locally-stored data forms the basis for the data analysis process and, on this basis, the user receives his or her information. From the programmer's perspective, this is understood as providing data that the user finds interesting.

> [...] basically the user downloads, double-clicks and from now on it [the service] has a homepage which updates for him he gets the things he finds interesting. This is the follow usually between 300 to 1000 different feeds for the user and then from there we pick something from 20 to 30% data items a day. – AMP 1, #00:09:13-8

As stated above, the installation process is rather simple and yet it is also lacks some transparency. Once the application is downloaded and installed, all subsequent steps are carried out automatically. The automatic procedures are something the interviewed programmers seem quite proud of, as the next citation shows.

> No, no it's completely automatic we have no... there is no vocabularies, there is no topic list, there is no source list (...) So what we do is automatically discovery of sources. It is automatically adapting so one thing is once you show interest in something then it starts to follow the sides that you found but we also expand it. – AMP 1, #00:09:47-5

In the previous two quotations, the programer described how their application follows between 100 and 300 data streams from which around 20% to 30% of the information is selected and presented in an information feed. Once the system starts working, the algorithmic procedures operate on their own. Incoming data is analyzed and, based on this, information is presented. It is often falsely assumed here that the programmers know exactly which sources are being analyzed and which information being selected or not. The given numbers in the citations are estimates because the algorithmic processes operate automatically without any control. This means that the algorithmic procedures are shaped in such a way that they can operate independently. This is called, in technical language, machine learning. In the interview, the programmer describes this process under the label 'automatic discovery'. Accordingly, following the idea of an action dynamic, it is beneficial to understand algorithmic media as frameworks created by programmers. The user operates within this framework and alters it simultaneously.

> So, that people who have been reading we actually built the algorithm in a way that you would get better quality articles but from more diverse sources. – AMP 7, #00:11:33-1

In the citation above, another programmer confirms what the other programmer stated earlier. He explains that they built an algorithm that is able to detect high quality articles from different sources. Their algorithmic service thus functions as an aggregator of news sources and, again, the user has the possibility of receiving information from several sources, related to their behavior. What remains unclear is how the different types of data are evaluated.

In the following quotation, the same programmer describes their procedure as looking into users' consumption patterns. He says that they do not look into the content itself but into content consumption patterns. In the second part of the citation, the interviewee further states that they look into the source and thereby the media company that stands behind the specific information.

> We basically take a look on consumption patterns. We don't look at the subjects of articles or anything like that. Instead we take a look on producers. Like writers and media companies. – AMP 7, #00:25:53-9

The citation above sheds light on the different sources of data to be analyzed. It shows that user behavior is not the only factor in news aggregation and that other factors are taken into account, e.g. the credibility of the sender. Unlike what is known from journalism studies, however, the content itself is not evaluated. This points to the idea that content is becoming popular due to its context. Statements about the content's popularity are made by evaluating the context of the information. One programmer emphasizes in this regard that these statements on content popularity need to be adaptable. He calls this a 'learning scheme':

> Your learning scheme has to be flexible. Not like a decision tree. If you like this go here, if not go here. This is not really working in this data world. – AMP 4, #00:16:40-0

Contrary to public opinion, the programmer explains that the data collected and presented in a learning scheme needs to be responsive. This means it needs to adapt to the behavior of the user as well as the changing environment of the digital world. As stated in the previous chapter, the internet and its underlying structure is ever-changing and it is important to acknowledge this when trying to understand information relevance in algorithmic media. This understanding is underpinned by the following citation, which explains the algorithmic learning scheme further.

> We develop an engine or a behavior model – we call it behavior model – that could consist of between a few thousands of elements, up to hundreds of thousands of elements, so we have very mature knowledge about the user. To compare the technology that has been there before [companyname], that knows to learn a few tens of items, we can learn thousands and hundreds of thousands. – AMP 2, #00:49:21-9

In the citation, the programmer talks of a 'behavior model', which relates to the idea of the learning scheme the other programmer was talking about in the earlier citation. The so-called behavior model consists of an undefined but high number of elements that get weighted against each other and eventually lead to knowledge about the user. In terms of the scope of this research, this means that a number of factors are taken into account in this learning scheme. How many items precisely feed into this calculation remains unclear, according to the interviewed programmers, and whether it is actually "hundreds of thousands", as the programmer states, is questionable and may be an exaggeration. Something important to take away from this, in this regard, however, is that within algorithmic media from a technical perspective it is not the content itself that is evaluated but the associated context and factors related to the user's behavior. The programmer confirms this finding several times in different ways throughout the interview. One example of this confirmation is the following quote:

> It's behavior-based; according to your behavior we learn from you and your intention essentially. – AMP 2, #00:52:39-1

As a tentative conclusion, it can be stated that the user's actions are translated into a behavioral model that is company specific. In order to translate the user's behavior into a representative model, a number of factors are included. These factors are summarized in flexible learning schemes and, from this, assumptions about the user's interests are made.

Further questions that arise from this relate to how aware content producers and algorithmic media users are of these translation procedures, and if and how they act on this knowledge. The next citation is from a content producer talking about how technology, especially automation technology, is thought of in the different companies he is working for. He states that there is generally an idea that technology can replace humans, which may lead to a decrease in the cost of such work. He further states, however, that many of his co-workers do not agree with this belief.

> Most of the managing board in the companies I work for, they understand technology as something which can replace humans and therefore make it cheaper to do stuff. But all the people I'm actually working with, those people doing stuff with technology, they're not seeing it that way. They're seeing it like, technology can do different stuff, that can make things easier, that can add to experiences, that can enhance experiences. But it's not to replace humans really, it's actually to produce more communication. – MP 1, #00:11:06-1

This citation shows two different kinds of understanding of technology. One looks at technology from a business perspective. Here, technology is checked for its potential, especially through the lens of effectiveness. An underlying question for managers is often how technology can contribute to streamlining processes. Technology is looked at as something that can make processes more efficient and thereby lead towards a reduction in cost, which may eventually lead to the replacement of humans. This understanding is visionary because it imagines technology doing things that are not currently possible. The other rather opposite understanding of technology looks at It through a practical lens and explores what can be done with it or, in other words, how it can enhance experiences. In this understanding, technology is more a practical tool, an extension to the human that can help in doing specific tasks. It is important to note that both understandings are equally valid but take place on different levels and have different consequences.

Moving towards the user perspective on action possibilities in algorithmic media, the following citations give an insight into what users know about algorithmic procedures and how they interact with them. In the following quote, the user talks about how satisfying the information was when displayed as relevant.

> Sometimes ... sometimes things were relevant and sometimes it was unsatisfying, you know, I didn't ... I wasn't getting the information that I wanted. You know, I was looking for ways to get more information on, you know, a lot of the things that I like to read about, or developing trends in social media, trends in market-

> ing techniques and general political trends as well, so I was looking at something that was going to generate that content for me without having to look too hard myself. – AMU 3, #00:04:37-1

The user starts off by saying that the information displayed was moderately satisfying. This means that it often related to his interests but that the relevance of the displayed information was sometimes limited. When the information did not mirror the user's interests, he looked for more information. What is interesting in this relation is that he stated he was looking "for ways to get more information". This shows that users are involved in the process of receiving information even though it is presented to them. The user states that when he was not satisfied with the information offered him by algorithmic media, he used the possibility of changing his behavior in order to receive information that was more relevant to him. What still remains unclear at this point is how users change their behavior. Nonetheless, what can be seen is that the user plays an active part in creating information relevance in algorithmic media and that, to a certain extent, there is awareness of this. This is confirmed later during the interview when the user states that he generally has a good understanding and awareness of algorithmic procedures. A notion that is surprising is the idea of keywords in relation to algorithmic processes. To my knowledge, this does not play a role in algorithmic media as content is not analyzed at the time of research. It does, however, show that the user is generally reasoning and thinking about the algorithmic procedures.

> I have a decent understanding, I wouldn't go too far and get as far as the actual algorithms, but I understand, there's a lot of new platforms out there that... you know, and a lot of start-up companies especially, that are looking to gear content towards... I don't know, like meeting keywords... and you know... for example, some applications, you can read a certain setup, you know, certain subjects and they'll come up more frequently. – AMU 3, #00:02:17-5

The following interview quotation from a different user supports the previous findings, albeit looking at the topic from a slightly more extreme position in that the user uses the notion of "manipulation" when talking about algorithmic media. According to him, algorithmic processes feel like manipulation. It is not a service that simplifies the receiving of information but one that might lead to bias.

> Yes, I am very interested in that thing because... I am very interested in how we are manipulated. – AMU 5, #00:11:01-9

The notion of manipulation is interesting insofar as it carries a negative connotation. One possible understanding of the notion is that users may be easily influenced. In the following, the user expands his thoughts:

> And so I have a lot of ... many times thought about that. And we have also in the radio we have spoken several times about that. I mean but not only in Twitter or Facebook or that. I am very upset about what Google is doing. And think in that: okay, they want to personalize our information. They want... taking into account the information we give them. The click we do. The things we see. Everything we do. They give personalized information but I wonder that if we are not getting more short minded. I don`t know ... you understand with that because everything we are getting is something with that someone else thinks it`s good for us. I don`t know if I can make me understand. I mean, really, we don`t choose what we see. Someone else chooses for us. And that is very worrying because I have got students and I am very interested in that point. – AMU 5, #00:11:14-6

In the citation, the user speaks about the possible consequences of personalized information, namely being narrow-minded. The user is worried that when information is given based on user behavior then the variety of information may be limited or even negative. While the consequences of algorithmic media are not the subject of investigation, it still shows that this user is aware of the general process. Interestingly, the user reasons that somebody else makes the decision regarding what information someone gets to see. The programmers argues the other way and that it is the user who gets the opportunity to decide – implicitly. The question 'who decides what we get to see' emerged several times throughout the interviews and is contested. While users often feel they have no say in the decision-making process, even though it is their behavior that gets analyzed, programmers have a diametrically opposed view on this matter. They believe it is the user that has the possibility of receiving information tuned to their interests.

### 5.5 Conclusion

The previous chapter presented, substantiated and discussed the four identified communicative dynamics. The first dynamic, termed strategical-functional dynamic, explains the idea of algorithmic media and goes deeper into the technical details. Like most other services, algorithmic media has been developed with a specific purpose in mind, which shapes and influences how information relevance arises in algorithmic media. The interviewed programmers stated that one of their main purposes was to reduce information overload. This means they wanted to create a service that automatically discovers information of relevance to the user and which uses automatic processes to do so. The second dynamic shaping information relevance in algorithmic media has been termed the narrative dynamic. The citations presented in this section show that the frames being used to describe algorithmic media have a significant influence over how algorithms are understood and perceived publicly. Behind algorithmic media stands a type of branding strategy that Is trying to sell a product rather than educate about specific algorithmic procedures. The narrative being presented feeds into the idea that algorithmic mechanisms operate beyond human control, even though technically speaking that is not the case, as the first dynamic shows. The last two identified dynamics, the knowledge-awareness dynamic and the action dynamic, are closely related to each other. Both dynamics deal with the processes of translating human behavior into algorithmic processes. Further, they look into how knowledgeable and aware users are of their own behavior and how this relates to what information they are receiving.

To reiterate, one of the main differences of algorithmic media is that information relevance that arises through an analysis of the user behavior. The empirical material supported and substantiated the assumption that information relevance is not only subject to technical procedures but also to social ones. This means that in order to understand information relevance in algorithmic media, it is important to take the complexity of the matter into account. It is no longer sufficient to reverse engineer algorithms; it is equally important to take the communicative aspects of algorithmic media into account. All this makes information relevance in algorithmic media and I will discuss and summarize the empirical findings in more detail in the following chapter.

# 6. Information relevance in algorithmic media – a morphological model and a critical reflection

The main goal of this research is to investigate how information relevance in algorithmic media arises. The starting point for this investigation has been a closer look at the digital context that algorithmic media is situated in and the practical operation mode of algorithms. On this foundation, the conceptual framework of algorithmic media as algorithm-user-communication has been established. In the subsequent two chapters, I then presented the methodological approach and empirical analysis. The empirical analysis has been substantiated with the gathered interview material. The following chapter now integrates the conceptual perspective with the empirical insights by proposing a morphological model that shall visualize and thereby help us to understand information relevance in algorithmic media from an application-based perspective. After presenting the model, I will then critically reflect on algorithmic media on a broader level, especially in relation to the concepts of 'power', the 'public sphere' and 'informed citizens'.

The first section of this chapter presents a morphological model that visualizes the complex communication processes underlying algorithmic media and which eventually constitute information relevance. The presented model is proposed as a 'model-to-think-with' and hence does not claim generalizability. Its purpose is to help understand how complex and fluid information relevance presents itself in algorithmic media. As described in the overall introduction to this research, algorithms are commonly understood as programmed factors; however, when it comes to algorithmic media, user behavior needs to be taken into account. Another goal of the presented visualization is thus to start a discussion about information relevance in algorithmic media from an application perspective, albeit without claiming that the presented model is final.

The three sections that follow the morphological model then draw on research literature in internet studies and related fields in order to comprehensively discuss algorithmic media in the digital realm. The first of these three sections is concerned with the relationship between algorithms, communication and power. All three concepts are broad concepts with no generally accepted definition, which makes their use in an academic sense challenging. I will therefore explore the relationship on a more general level by giving insight into current literature and then, based on that literature, discuss the concepts in relation to the research object.

The discussion on algorithms, communication and power is followed by an inquiry into the connection between algorithms, filter bubbles and the public sphere. The concept of the public sphere is well-known and extensively discussed, and so it is only presented in outline here. However, in relation to the social implications of algorithmic media, the idea of a public sphere raises several intriguing questions, which I will consider in more detail.

In the last section I discuss algorithmic media in relation to the concept of the 'informed citizen'. The demand for an informed citizenry is an ancient one and the question in this regard is if and how algorithmic media contribute towards informing citizens, which is considered a necessity in democratic societies.

## 6.1 How information relevance arises in algorithmic media: Towards a morphological model

The following figure 17 summarizes the insights gained during this research and visualizes the emergence of information relevance in algorithmic media in its constant state of flux. As a visualization, the figure's function is to support the outlined application-based understanding of information relevance in algorithmic media from a communication perspective. It should be understood as a 'model-to-think-with' and does not claim to be conclusive or definite. It is meant as a contribution to the ongoing discussions revolving around algorithms in the digital realm. The notion of a 'model-to-think-with' is derived from Jensen's (2012) idea of understanding modern media as 'institutions-to-think-with', which in turn is related to anthropologist Lévi-Strauss, who established the concept of 'objects-to-think-with'. The role of media is, according to Jensen, to create meaning and to enable processes of reflexivity in society. He writes:

> To sum up, the modern technological media as social institutions are embedded in, but enable reflexivity about, the time-in of everyday life. They are institutions-to-think-with. (Jensen, 2012, p. 6)

Jensen offers a cultural perspective on media by stating that media is involved in the process of meaning-making and that media institutions contribute towards reflections on everyday life. Therefore they can be understood as institutions-to-think-with.

The idea of a model-to-think-with is also reflected in the given subtitle: 'morphological model'. The term morphology allows to highlight the flexible communicative materiality of information relevance in algorithmic media. According to Aronoff and Fudeman (2005), the term morphology was coined by Johann Wolfgang von Goethe in the early 19th century and is derived from the Greek word 'morph' for 'shape' or 'form'. Essentially, morphology is the study of form(s) and, depending on the specific field, it is also the study of structures, configurations or formations.

Digital communication takes place on the premise of digital communication technology and this technology is continuously evolving. It is important to have this in mind when investigating information relevance in algorithmic media. The focus of the proposed model is hence not primarily on the technology itself but on the versatile communicative dynamics of algorithms and their users. As communication and the technological materiality are inevitably linked, however, the given name of 'morphological model' also covers this even if it is not the primary focus. The model is shown in the following figure and, to reiterate, it is a visualization that supports an application-based understanding of information relevance in algorithmic media.

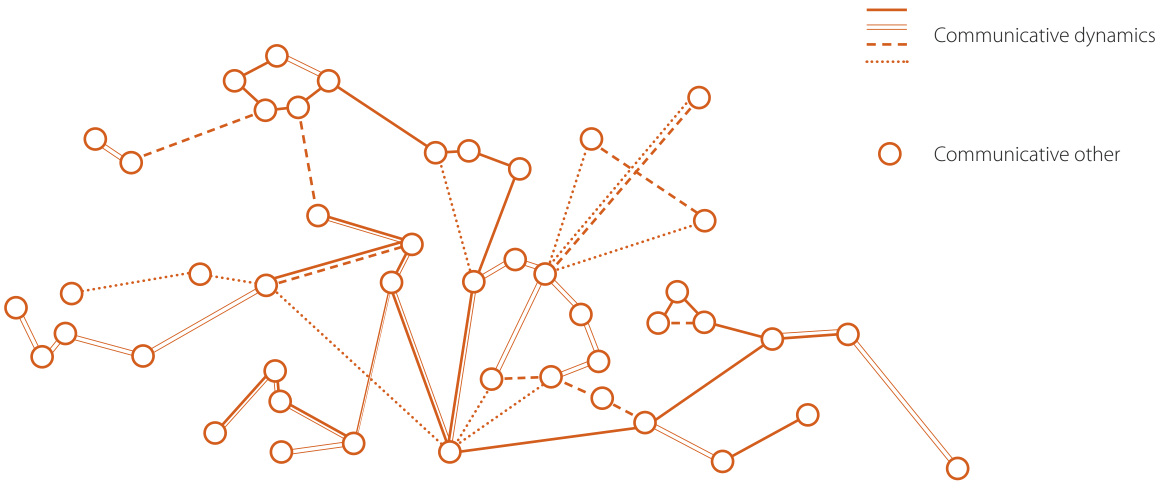



Figure 17: Morphological model of information relevance arises in algorithmic media

The morphological model consists of a number of dots and lines representing the different parts of the model. The small circles represent 'communicative others', a concept which is derived from Gunkel (2012) and explained in detail in chapter 3. The communicative dynamics that resulted from the analysis of the empirical interview material (see chapter 5) are represented by the different lines. In its current state it has four lines, as four dynamics have been identified. The dots are connected through the lines and it can here be seen that not all dynamics are always in play. This visualizes the constant state of flux in information relevance as it constantly changes form.

As mentioned above, the presented visualization aims to combine the established conceptual lens with the empirical findings, more specifically the fact that information relevance is subject to algorithm-user-communication and that algorithm-user-communication is shaped by communicative dynamics. The visualization further shows, through the diversity of the lines, that not all algorithm-user-communication is shaped equally but as mentioned in the last chapter through various communicative dynamics. In this regard, the chosen line types demonstrate the versatility of the communicative dynamics. Further, the visualization shows that information relevance in algorithmic media does not have a clear center nor a definite border: it arises through the constant process of communication. Additionally, it is important to note that there is not just "one" algorithm or "one" user. Algorithms are constantly being developed and users adapt and change their behavior accordingly. According to the conceptual understanding of information relevance in algorithmic media, the visualization does not explicitly distinguish between algorithm and user and hence shows a number of communicative others connected with one another via communication.

The value of the proposed model lies in its ability to rethink information relevance in algorithmic media. As discussed several times throughout this research, explanations solely based on algorithmic functionality underestimate the role of user behavior. Having created this visualization, I hope to contributing to a fruitful discussion on how to integrate user behavior when analyzing algorithmic performance. This also adds a certain level of complexity, which the proposed model shall reflect. It shows that algorithms-user-communication is a complex process.

Having summarized and visualized information relevance in algorithmic media, I will now discuss the model and the research conducted through a critical lens. I will here draw on current research in the field of critical algorithm studies. The field of studies on algorithms has grown extensively over the past years and contributed with valuable knowledge. In the next section, I will present selected research that helps to critically reflect on this research. It will furthermore provide the necessary context to understand the proposed model in more detail. It is also important to note in this regard that I will not provide a systematic overview of the available literature in the field (this would not be feasible) but will instead use a selection of studies that highlights the core discussions in relation to the scope of this work. One important discussion in this regard is the question of power, which I will discuss in the following section.

### 6.2 Communication, algorithms and power

The relationship between algorithms and power is of great importance and hotly debated both publicly and in current research. While researchers in the field seem to generally agree that algorithms execute power, it is still unclear exactly how algorithmic power emerges and what form it takes. According to Bucher (2012), algorithms execute power over the visibility of information and thereby over the distribution of knowledge. Bucher argues, in her often cited article *Want to be on top? Algorithmic power and the threat of invisibility* on Facebook, that algorithms structure the flow of information and communication on Facebook's News Feed through disciplinary methods. According to her, this affects the behavior of the user, who has to completely adapt to the structure provided by the algorithm in order to create visibility. Comparing algorithmic structure to Foucault's panopticum, she states:

> Thus, EdgeRank, by functioning as a disciplinary technique, creates subjects that endlessly modify their behaviour to approximate the normal. Because interaction functions as a measure for interestingness, practices of Liking, Commenting and participation become processes through which the subject may approximate this desired normality. (Bucher 2012, p. 1176)

The starting point of Bucher's argument is the idea that information visibility is structured hierarchically through the architecture specific to algorithms. According to her understanding, being able to generate visibility means being shown at the top of

Facebook's News Feed. If users wish to create visibility, which then may also create popularity, according to Bucher, they therefore have to follow and adapt to the logic of algorithmic structure. If they fail to do so, they may face the "threat of invisibility" (p. 1171), that is to say, the information they share may not be visible on Facebook's News Feed. The presented perspective on algorithmic structure implicitly carries the idea of algorithmic hegemony and further includes the notion that algorithms possess power over the design of information flows.

Beer (2009), when also discussing the notion of power in relation to algorithms, introduces the concept of 'power through the algorithm' by drawing on Lash (2007). His main argument is that, in the digital age where users are actively involved in content creation and other forms of collaboration, new forms of power arise, and these need to be examined. In conclusion to his work, he suggests that Lash's notion of 'post-hegemonic power' may be a valuable analytical framework as the contemporary digital media call for new rules of engagement. In this article, Lash (2007) discusses in great detail the notion of power from a historical perspective and offers a view on power other than the typical notion of hegemony. He starts his argument by describing the "age of hegemony" (p. 59). He writes that, in the age of hegemony, one type of power can essentially be found, namely power in form of 'power-over'. The concept of 'power-over' describes the fact that "individuals or collectives or structures made others do what they otherwise would not do" (p. 59). That is to say, people were forced to do something against their will, often while facing harsh consequences. In what Lash now calls the "post-hegemonic age" (p. 59), another type of power can be identified, namely power as 'force' or 'energy'. Lash (2007) states:

> The hegemon is above. It is outside and over. In the posthegemonic order, power comes to act from below: it no longer stays outside that which it 'effects'. It becomes instead immanent in its object and its processes. (p. 61)

In his work, Lash distinguishes between hegemonic power, which results in hierarchy, and post-hegemonic power, which is inherent in objects, processes and systems. In his understanding, systems do not execute power in the form of 'power-over' but in the form of 'force'. Power is inherently included in the system. Lash argues that Foucault's panopticum understands power in terms of 'power-over' because it is described in relation to surveillance and discipline. The question that can now be asked is whether this hierarchical understanding is a sufficient and valuable understanding of algorithmic power. As mentioned above, Bucher applies Foucault's lens in her work to understand algorithmic structure and thereby also algorithmic power. In contrast, Beer's understanding of 'power through the algorithm' questions the idea of discipline as algorithms cannot execute "power-over" the user or other structures.

It is unquestionable that algorithms possess a certain kind of power and these two articles show the two dominant understandings of power in relation to algorithms. On the one hand, algorithms are understood as entities or software mechanisms executing power over something or someone and, on the other, as having immanent power. These understandings are not necessarily mutually exclusive but are differentiated by their starting points and underlying assumptions. It seems that Bucher, in her writing, assumes a rather passive user. A user that interacts, likes and comments but who does not start to playfully engage in the algorithmic system, that does not start to challenge the algorithmic system in any case. Beer, in turn, builds his article on an understanding of algorithmic power in the Web 2.0 development, which he sees as marking the shift from solely professional content towards user-generated content and a participatory culture. Alongside these ideas of user-generated content and participatory culture are discussions on empowerment and democratization. While initial hype around the democratic potential of social media quickly turned into disillusionment, recent debates still believe in the democratic potential of Web 2.0 technologies.

In relation to the focus of this research, the question of power is also closely related to the question of communication. When algorithmic media is analyzed from a communicative lens, the question arises as to how communication relates to power. Sociologist Castells (2007) writes in this regard:

> Throughout history communication and information have been fundamental sources of power and counter-power, of domination and social change. This is because the fundamental battle being fought in society is the battle over the minds of the people. The way people think determines the fate of norms and values on which societies are constructed. (p. 238)

In his work, Castells distinguishes between the two opposing notions of 'power' and 'counter-power'. He understands power as the "structural capacity of a social actor to impose its will over other social actor(s)" (p. 239). He therein ascribes media a fundamental role in society and politics, operating within a technological framework. This means that, in Castell's understanding, technology builds the framework in which social actors exert power. According to his understanding, actors do not exert power through behavioral restrictions but through communication that targets the minds of people. In the second part of the citation he writes "the fundamental battle being fought in society is the battle over the minds of people". Here, communication functions as a means of targeting people's minds and subsequently people's actions. Castells thus advocates for the idea that it is the way people think about a certain issue that mostly influences the course of societies.

This brief inquiry into the notion of power in relation to algorithms and communication shows how diverse and manifold the perspectives are. As all perspectives are based on different assumptions, a consensus does not seem feasible at the moment and is perhaps not even needed as all perspectives offer valuable insights into the matter. Combining the different ideas by looking at algorithmic media through different understandings of power contributes to the broader picture of how algorithms impact current society.

In relation to this work, Castell's communication perspective seems most valuable when talking about power, even though a structural view seems more obvious. His perspective offers a communications view on power and it is thus suitable to add and discuss the presented morphological model. Following Castell's argument that it is the people's convictions that govern society, the proposed communication perspective on information relevance in algorithmic media hopes to contribute towards an understanding that helps users become more conscious of their own behavior and thereby their own agency. Shifting one's mind from an hierarchical understanding of algorithms that exclusively decide information flows to a communicative understanding of algorithms that constantly relate to our behavior may be valuable insofar as it creates empowerment. Understanding information relevance as algorithm-user-communication may offer the necessary room for attempting to influence information flows in a desired way. What this entails, however, is a great amount of responsibility. That is to say, users do have a responsibility to constantly engage in the information they receive and its validity, and they need be active in finding out if there are other important issues going on in the world. This calls for a constant observation of one's own behavior, which not every user may wish for or be capable of. The proposed perspective consequently raises further questions in relation to algorithmic literacy and information practices.

## 6.3 Algorithms, filter bubbles and the public sphere

Another ongoing public and academic discussion is the issue of how algorithms and, more specifically, algorithmic media contribute to filter bubbles (Pariser, 2011) which, in the political realm, are also referred to as echo chambers (Sunstein, 2001), and to the potential distortion of a vital public sphere(s). One of the biggest concerns, which is often mentioned, is that algorithms may create impenetrable information spaces that leave people isolated and unchallenged in their opinions. Throughout the period of this research, the concept of a filter bubble could not be proved as empirically true (e.g., Jürgens, Stark and Magin, 2014); however, it can be empirically observed that more and more people are being exposed to algorithmic filter and recommendation systems, especially in the field of news, as more media organizations implement algorithms on their news sites. Researchers are only just starting to learn what the possible consequences may be, even though the initially rather bleak pictures painted in relation to the social implications did not turn out to be true. The rather extreme scenario of people being completely isolated can therefore be ruled out. Nevertheless, it is still valuable to discuss the idea of filter bubbles or echo chambers in a weakened version. That is to say, information is being presented according to user interests rather than to perceived societal relevance. What can be observed in the digital news realm is an ongoing shift from societal relevance to personal relevance. In order to discuss what this entails further, I will take a look at the concept of the public sphere in the following.

The concept of a public sphere was introduced by the German philosopher Jürgen Habermas and is well-known and discussed from different academic perspectives. Habermas, who also coined the term, describes the public sphere as "a domain of our social life where such a thing as public opinion can be formed" (Habermas, 1996, p. 105). It is Habermas' life work to make a strong argument for the imperative of a rational and open public sphere in which individuals have the opportunity to come together to discuss political and social issues. In addition, he goes as far as to state that democratic societies depend on such a space, in which information, ideas and debate can circulate freely and political opinion can be formed.

In an extension to Habermas' work, media researcher Dahlgreen (2005) defines the modern public sphere as "a constellation of communicative spaces in society that permit the circulation of information, ideas, debates, ideally in an unfettered manner, and also the formation of political will" (p. 148). Dahlgreen also advocates for a space in which public opinion and debate can take place; however, accounting for modern communication technology puts emphasis on the circulation of information. The internet plays a contested role in this matter as it is still debated as to whether political discussions and dialogue increase or decrease through digital communication. While some researchers believe citizens are more exposed to political discussions (e.g., Holt, 2004), others found that heterogeneity prevails and is even partly supported (e.g., Brundidge, 2010). A number of researchers further claim that the internet reinforces preconceived political opinions (e.g., Bimber & Davis, 2003; Mutz & Martin, 2001). Sunstein (2001) refers to this as 'echo chambers'. He states that

> (...) the risk of fragmentation, as the increased power of individual choice allows people to sort themselves into innumerable homogeneous groups, which often results in amplifying their preexisting views. (p. 2)

Sunstein argues that the internet is prone to what he calls "gated communities" (p. 2), which prevent people from having shared experiences. To illustrate this, he mentions Daily Me, which is based on the idea of receiving information that is solely tailored to one's own beliefs and interests.

Habermas' philosophical concept of a public sphere has been extensively critiqued, especially for its normativity (e.g. Hayes and Giddens, 1984). The same critique could made of Sunstein's echo chamber, and of all other writers who call for an open, rational and unbiased debate. This kind of debate demands highly rational and well-educated citizens who can set their personal opinions aside for the greater good; in practice this may hardly be feasible. A study that examines users' knowledge of algorithms and their ability to reflect algorithmic procedures shows that more education is needed and users need to become aware of their own agency (Eslami et. al, 2016). Eslami et al. (2016) conclude:

> In fact, in most of their proposed theories, they did not see themselves as possessing any agency; either the content creators or the algorithm determined what they saw.

Starting with the observation that algorithmic processes are mostly lacking in transparency, the paper investigates how users think Facebook's News Feed algorithms work. The study identifies ten so-called 'folk theories' which shed light on how users generally think and make sense of algorithms. In the study, folk theories are defined as "non-authoritative conceptions of the world that develop among non-professionals and circulate informally" (p. 2). Simply speaking, folk theories are beliefs and ideas that users have about the way in which algorithms work. One of the most common theories users employed was what the authors termed the 'personal engagement theory'. This theory reflects the belief that the number of interactions with another person on Facebook determines the visibility of information. The types of interactions users mentioned included practices such as liking or commenting on a friend's story. The study further shows that some of the users actively adapt their behavior to this theory and start liking or commenting on a friend's post when they would like to receive more information from that person.

Another popular user theory is the 'global popularity theory', which reflects the users' belief that the number of likes, that is to say quantitative measurements, determines the visibility of information on Facebook's News Feed. Eslami et al. (2016) writes:

> A few participants said that they used The Global Popularity Theory to affect their News Feed. For example, because News Feed can not contain everything and it prioritizes popular content, they sometimes unfollowed friends who produced popular content to be sure there was enough "open space" for stories from others. (p. 6)

TThe 'personal engagement theory' and 'global popularity theory' can generally be considered valuable and helpful when interacting with algorithms. The following user theories discovered by Eslami et al., however, are rather unexpected and show how diverse algorithms can be perceived. One of the more unexpected theories is the 'narcissus theory'. This user theory points towards the belief that similarities between people, either personal or relational, influence what becomes visible on Facebook's

News Feed. Some users believed that the more they had in common with another person e.g. same personality or being related, the more stories they would receive from that person. Another rather unexpected theory is the 'OC theory'. The abbreviation OC stands for original content and means that some users believe that original content as opposed to shared content receives more visibility.

In total, the study identifies ten folk theories but, because it only investigates the users' belief and not the algorithmic procedures themselves, it remains unclear whether or not these theories are factually true. Overall, the study gives an insight into how different and widespread the knowledge of algorithms is and how insecure and partially unaware users are of algorithms. In relation to Habermas' and Dahlgreen's call for a public sphere in which all opinions can be freely expressed and circulated, it seems that more knowledge and education is needed.

This section took its starting point in Habermas' concept of a public sphere and the question of whether or not algorithms disrupt or even prevent such an idea or even democratic need. Current research disagrees; some writers argue that algorithms contribute to the emergence of filter bubbles or echo chambers and entail several risks. Others point to the democratic potential of digital media and predominantly see opportunities. In relation to this research, this discussion highlights the importance of the user. Depending on the level of algorithmic awareness, the user can contribute to the reinforcement of filter bubbles and similar phenomena or contribute to their reduction. Used in a conscious way, algorithms can provide information that is of personal interest and simultaneously of societal interest and thereby possibly even motivate friends and other individuals to engage in news. Algorithms include the possibility of users receiving information that is actually relevant to them and thus motivates them to engage in society.

## 6.4 Algorithms and the informed citizen

The previous section focused on questions related to algorithms on a structural level and user knowledge of algorithms. The following sections focusses on the individual citizen. When discussing concepts such as the public sphere and the related idea of public opinion, another concept often mentioned as a prerequisite is the 'informed citizen'. While the public sphere spans structurally across societies on a macro level, the informed citizen is situated on a micro level. It is generally expected that citizens should make valuable political contribution on an informed basis. In the following, I will therefore look further into what the concept of an informed citizen entails.

The concept of an informed citizen dates back to early philosophical writings on citizenry and democracy; it is often also examined under the notion of the good citizen. A well-known and more recent writer in this matter is Austrian philosopher Alfred Schütz (1946), who talks about the 'man on the street', the 'expert' and the 'well-informed citizen'. The overall topic of his essay deals with the social distribution of knowledge and starts with the assumption that modern society in its entirety cannot be understood by a single individual. Even though there is theoretically a stock of knowledge available, in practice this knowledge cannot be fully applied as it is subject to systems based on different assumptions and frames of reference. Individual actions hence often need to take place on the basis of previous experiences and under information uncertainty.

Based on these general observations, Schütz' essay inquires into why certain matters in life are accepted without further question while others are subject to questioning. In the course of the essay, he analytically distinguishes between three different types of actors, all of whom possess different types of knowledge. The first actor he describes is the expert.

> The expert's knowledge is restricted to a limited field but therein it is clear and distinct. His opinions are based upon warranted assertions; his judgements are not mere guesswork or lose suppositions. (Schütz, 1949, p. 465)

According to Schütz, the expert possesses very specific knowledge in a specific area. The expert's knowledge is not generalizable nor widely applicable but it is clear and distinct. Simply put, the expert possesses specific knowledge in a defined area. The concept that opposes the idea of an expert is the 'man on the street'. The man on the street makes use of recipe knowledge. His knowledge is wide and incoherent and he knows that certain procedures work, even though they are not fully understood.

> The recipes indicate procedures which can be trusted even though they are not clearly understood. By following the prescription as if it were a ritual, the desired result can be attained without questioning why the single procedural steps have to be taken and taken exactly in the sequence prescribed. This knowledge in all its vagueness is still *sufficiently* precise for the practical purpose at hand. (Schütz, 1949, p. 465, emphasis in the original)

The citation shows that the man on the street possesses a different kind of knowledge to the expert. He basically knows procedures and their outcomes but does not know exactly why the procedure works. Through experience and other sources of knowledge, the man on the street has established ideas and beliefs that work for him as guides and which he can rely on.

After describing these two types, Schütz proposed the ideal type, which is for him the 'well-informed citizen'. The term well-informed citizen is short for "the citizen who aims at being well informed" (p. 465).

> On the one hand, he neither is, nor aims at being, possessed of expert knowledge; on the other, he does not acquiesce in the fundamental vagueness of a mere recipe knowledge or in the irrationality of his unclarified passions and sentiments. To be well informed means to him to arrive at *reasonably founded* opinions in fields which as he knows are at least mediately of concern to him although not bearing upon his purpose at hand. (Schütz, 1949, p. 466, emphasis in the original)

Schütz acknowledges that all concepts presented are analytical constructions for the matter of inquiry and that, in daily life, citizens' roles and ideas shift constantly between the expert, the man on the street and the informed citizen. However, where the outlined types differ is in the kind of knowledge that is taken for granted, what is questioned and what the point of reference is. The man on the street takes knowledge as such for granted and does not ask questions in order to understand the origin and structure but rather to "make things work". His acting and thinking is not primarily influenced by information but often by sentiment, and he builds on experience and intrinsic reference points and trusts those. This person apparently prefers comics and quizzes to news and information (Schütz, 1949).

The expert is quite the opposite. His knowledge is bound within a rather narrow frame and the problems he is interested in are related to the problems posed in his field of interest. In this field of interest, the expert establishes a certain frame of knowledge within which he orients himself, when giving advice. The expert's knowledge is driven by problems in his field and he is driven by developments in his field. His knowledge is explicit and detailed and the application range may be low. The expert is better able to answer to the question of why things work than to create practical procedures. Schütz has defined the expert in contrast to the man on the street to show the difference between both concepts. While the man on the street works with applicable knowledge, the expert is interested in theories. In this regard, it is important that Schütz makes no hierarchical distinction between both, neither one is "better" than the other. On the contrary, he proposes a mixture of the two, which he calls the 'well-informed citizen' as the ideal type.

The well-informed citizen finds himself between the man on the street and the expert. What makes this type ideal is that he has several frames of references he can draw on and that he aims to gather as much knowledge as is possible and feasible. He thus draws on both expert and man-on-the-street knowledge. According to Schütz, the well-informed citizen is mindful of what is relevant and what is irrelevant to a problem.

> Thus, his is an attitude as different from that of the expert whose knowledge is delimited by a single system of relevances as from that of the man on the street which is indifferent to the structure of relevance itself. For this very reason he has to form a reasonable opinion and to look for information. (Schütz, 1949, p. 475)

As mentioned above, Schütz' primary area of investigation is how the presented types differ in their approach to knowledge. The well-informed citizen is rather flexible from that perspective as he can draw on a number of reference frames and also shift between them. While the man on the street may be more interested in the solution than the knowledge itself, the expert's reference frame is very specific. One could therefore argue that Schütz' essay is an inquiry into the citizen's mindset. While the expert's mindset seems to be inflexible as it is bound to a specific frame of reference, the man-on-the-street's mindset seems too open as it is not bound to any reference frame. The well-informed citizen, situated in the middle, is able to make use of both.

For Schütz, the question is related to the distribution of knowledge and, as regards this research, it relates to the basis and process of handling information and the knowledge that can be derived from this. As not all knowledge can be experienced first-hand, the question is how to create a basic frame of reference that allows the necessary openness Schütz proposes. Schütz distinguishes between knowledge derived from one's immediate own experiences, the immediate experiences of another, an opinion of another based on different facts or a different source and an opinion of another based on the same facts or the same sources. Schütz considers socially-approved knowledge to be the most powerful knowledge, that is to say, knowledge that is produced from one's own original experience and which is then confirmed by someone else with authority. If it is now assumed that individuals receive information via algorithmic media that confirm their own experience, and this not just once but several times, then algorithmic media could potentially contribute to producing such socially-approved knowledge. However, this only happens if the same knowledge or opinion gets repeated several times over. As algorithmic media is geared towards personal interests but not towards the "sameness" of information, this is most likely not the case.

What may be challenging when looking at algorithmic media through the lens of Schütz is that either generalists or experts are produced. If, for example, a person is interested in very different fields and behaves accordingly on the internet, he will most likely obtain a variety of information that leads to recipe knowledge as described in the man-on-the-street scenario. If a person has one or two specific interests then algorithmic media will give more information on those, and this then leads to expert knowledge and a specific frame of reference as described in the expert scenario may be established. Both scenarios are not ideal in Schütz' understanding and it is therefore important not only to look at what kind of information can be received via algorithmic media but also what they are contributing to. Aiming at balanced information means, as Schütz describes in the ideal well-informed citizen type, drawing on different frames of reference. Shifting between those frames of reference is what eventually alters knowledge and thus makes a well-informed citizen.

Schütz idea of the well-informed citizen, with its focus on knowledge, differs from other ideas of the informed citizen that highlight political participation. In this respect, communication technology is examined under the aspect of offering the possibility of being able to participate in the governmental context. Macintosh and Whyte (2008) call for effective information provision in relation to citizen participation. But what does that actually mean? Taking Schütz' approach, it is not so much about the right information but about how that information is processed and made sense of. Assuming that algorithmic media addresses citizens, it is not about the quantity or the "right" information but about offering a frame that allows for flexibility. Here, the audience needs to deal with ambivalence, as Schütz argues that no one person can either experience or know everything about the world. All citizens are part of a process of generating collective knowledge about our world and they do that not only by receiving information but also by making sense of it. This again feeds into their behavior, which is recorded by algorithms and used for analysis. As informed citizens, it is therefore important to note and accept that when using algorithmic media the user is part of a process and that knowledge production is also taking place through user clicks.

## 6.5 Conclusion

In the previous chapter, I presented a morphological model that visualizes information relevance in algorithmic media in its constant state of flux. It incorporates both the conceptual perspective developed and the empirical material gathered. The model is proposed as a 'model-to-think-with'. It is meant to spark discussion about information relevance in algorithmic media and does not claim universal validity.

The presentation of the model was followed by a broader critical discussion of algorithmic media in relation to the concepts of communication and power, filter bubbles and echo chambers, the public sphere and the informed citizen. All current questions and concerns regarding algorithmic media are linked to these broader areas of discussion. First, the concept of power was examined in close connection to communication, and the question was raised as to whether power is executed in terms of "power-over" or if there are other ways of understanding power in relation to algorithms. Another suggested way of understanding power in relation to algorithms is the idea of "power-through". From this perspective, power is not understood as something external but as a part of a system. There is no common agreement amongst researchers as to how to understand power in relation to algorithms; however, in relation to this research, the notion of "power-through" seems most valuable. Power is part of the communicative dynamic and thereby inherent to information relevance.

In relation to the public sphere, one major critique of algorithmic media is that it may contribute to the development and manifestation of so-called filter bubbles or echo chambers. As the public sphere is a normative ideal in society, the question is not only how algorithmic media becomes a part of the structure that forms the public sphere but also what knowledge users have in order to engage in the mechanisms algorithms produce. A study has shown that the knowledge of algorithmic performance is still under development and that algorithmic structure is sometimes taken for granted. In those cases, it may very well be that algorithmic media contributes to the distortion of a valued public sphere. However, the study also showed that some users are creative in how they deal with algorithmic performance and they hence become a part of creating a reasonable public sphere.

The last section engaged with the concept of the informed citizen, particularly in Schütz' idea of the well-informed citizen. Schütz distinguishes between three different concepts in the approach to knowledge. While the man-on-the-street operates by way of well-established routines of action, the expert creates specific frames of reference. The man-on-the-street operates specifically with the question of how and the expert with the question of why. As an ideal version, Schütz proposes the well-informed citizen, which is characterized by flexible knowledge frames of reference. He balances routine and knowledge and ideally integrates the two. The concept of the informed citizen is valuable insofar as it serves not only as an ideal that society should strive for but also as an ideal of how to approach algorithmic media. As stated in the beginning, algorithmic media is under constant development and thereby in flux, and this calls for citizens that are flexible to changing their routines and gathered knowledge.

# 7. Concluding remarks

The goal of this research was to investigate how information relevance arises in algorithmic media. In answer to this question, I proposed a morphological model that visualizes information relevance in algorithmic media in its constant state of flux. The model is based on the insight that information relevance arises from algorithm-user-communication. Typical starting point for research examining the functionality and operation mode of algorithms are centered around a mathematical-theoretical understanding of algorithms as "step by step instructions, to be carried out quite mechanically, so as to achieve some desired result" (Charbert and Barbin, 1999, p. 1). This has led to an algorithmic-centered view, largely disregarding the role of the user behavior. However, a patent description of an application that uses algorithmic procedures to personalize information shows that the actual user behavior is a crucial aspect when information gets personalized. It is thus of great importance to incorporate user behavior as an essential component when studying information relevance in algorithmic media.

Algorithms are programmed for and executed by computational machines, which makes them difficult not only as research objects but also in terms of access. From an everyday perspective they are incomprehensible and complex and most users just want them to work. Instead of inquiring further into the mathematics of algorithmic procedures, this research therefore uses a communicative approach to understand and explain why certain information obtain extended visibility. As a starting point, algorithms and users are treated equally as communicative others. Conceptualizing algorithms and users as communicative others shifts the focus from the mechanics of algorithms to the algorithm-user-relation. This opens up the possibility of describing information relevance in algorithmic media from an application-based perspective.

In other words, based on the actual operation mode of algorithmic media in practice. By using the operation mode of algorithmic media in practice as a starting point, this research hopes to contribute to the development of a novel basis algorithmic media gets evaluated on. Further, the hope is to spark a discussion in the field on how to establish a sustainable theoretical understanding of digital applications, which are constantly being developed further and thereby subject to constant change.

A suggestion this research makes in this regard is to look at the communicative relation between the programmers, the content and the users. How do the applications communicate with their users? What shapes their relation? What is and becomes in-/visible? Then the researcher should take a step back and conceptualize the relationship using established or newly-defined concepts in the field of internet studies and related disciplines. Once this conceptual perspective has been formulated, the empirical investigation can start. Here, a wide array of methods can be applied, from traditional qualitative and quantitative methods to more experimental design methods. The method should be chosen according to the research question. This application-based inquiry then contributes with knowledge on digital services in practice and thereby creates concepts that are strongly rooted in ongoing technological developments. It is important, in general, to bear in mind that algorithms and related services are created and maintained daily by programmers who wish to create systems for a defined group of users.

## 7.1 Being informed in the digital age?

This research started out by asking what it means to be informed in the digital age, where algorithms have become an inevitable part of digital media. Formulated pointly, the question could be one of whether or not it is actually possible to be informed using algorithmic media. In general, experts are skeptical. There is a common concern that algorithmic media will lead towards a news landscape that is solely based on criteria of convenience. This means that news articles in relation to market values such as entertainment and general interest will be over-represented and, further, that preformed opinions will be confirmed rather than challenged. From the knowledge I have gained throughout this research, I believe the question is not so much of whether one can be informed using algorithmic media but how algorithmic media can be used as an everyday information source. In this regard, this research proposed a 'model-to-think-with', which serves as a basis from which I will discuss the notion of 'being informed' in what follows. Like any other media, algorithmic media also combines opportunities and challenges in this regard.

An important point in connection to algorithmic media is to understand the notion of 'being informed' as a process. Being informed is not a final state that can be measured, as a skill or competence, by objective criteria; it is a way of engaging in the world that information algorithmic media entails. Information that receive extendable visibility should not be taken for granted as journalistic facts but users should critically engage with the information and challenge what they get to see. In particular, when considering an informed citizenry as a pre-requisite of modern democracies, users need to embrace the fact that being informed requires continuous action and behavioral self-reflection. Bearing this in mind, algorithmic media creates a valuable set of possibilities. For users, it creates the unique opportunity to be actively engaged in the process of making information relevant. They can do so by playing around and experimenting with their behavior and the given structure. Because algorithmic media functions on the basis of an analysis of user behavior, users will start to see how algorithms mirror their behavior once they start experimenting with them. Once users have realized their own impact, they can start using this to their own advantage. For example, they can create a feed of information that they perceive as authentic.

This great opportunity comes with a high responsibility, however, and one which might challenge a number of users not to mention society. When using algorithmic media, it is no longer a choice to simply receive news in a rather passive way. Users need to be actively engaged and keep themselves updated with regards to technological developments. Otherwise, the system may not work and an outcome will be created that might be counter-intuitive and misleading. As the visibility of news is strongly related to a variety of behavioral factors, users will need to learn how they can influence the given frame. This is simultaneously a major challenge and major opportunity that users and thereby society are facing in relation to algorithmic media.

For content producers, algorithmic media offers the opportunity to include information that is only of interest to a specific number of users. As the distribution of information can be highly personalized, e.g., users can be targeted individually, niche topics, opinions and writings may find their way into the more general news realm. This offers users the opportunity of receiving different information from what they would typically receive. The challenge lies, here again, in the process of how to deal with the information. A mentioned earlier, the responsibility shifts to the user: they cannot rely on the general idea of information that they are used to in journalism.

Overall, algorithmic media is a young member of the digital realm. Algorithmic technology will be further developed and news and information will become more and more personalized. Algorithmic media thus offers new ways of receiving and engaging in news but it will also challenge the very foundations of the journalistic system. As ethical guidelines and legal frameworks are not fully established for algorithmic media, users need to educate and challenge themselves when using them. In this respect, algorithmic media is not and does not want to be a reliable source of balanced political information. It is important to bear in mind that the intention of algorithmic media has been to build a structure that allows users to receive information tailored to their interests. It would be a misconception if users were to sit back and use algorithmic media on the same premise as traditional journalistic news media.

## 7.2 User agency

An important issue that is often overlooked in relation to research on algorithms is the concept of user agency. Throughout this research, I have argued for a strong connection between algorithms and their users and I therefore believe it is important to put more focus on the user when studying algorithms. In current studies, the user is under-represented and poorly conceptualized. In general, current research on algorithms can give the impression that users are assumed to be rather passive and without any specific knowledge. While this research cannot make any statement about the competences and knowledge of users in relation to algorithms, it is still valuable to assume that users are able to make active decisions and that they further do not merely take any information for granted.

Assuming a knowledgeable user offers the opportunity of creating different insights in relation to algorithms. Another take-a-way of this research is hence to start investigating in the question of how users can be conceptualized and made fruitful for the research process, even though the focus of the inquiry may lie in algorithmic procedures. In this regard, the concept of an 'engaged user' can be derived from this research. According to the interviews conducted, users are aware of the impact that algorithms have on information flows. This, however, does not detract them from using algorithmic media. On the contrary, it seems they are reflective about their own use and how their actions contribute to the information they receive. However, the interview material also shows that users are only just at the beginning of understanding the context of algorithmic media. As this is a new type of media, new practices need to be established and it seems likely they have not yet manifested themselves. Media routines are often still affected by learned routines connected to ideas and concepts of traditional media.

## 7.3 Outlook and further research

The question this research leaves with is how algorithmic media can contribute to a valuable flow of information, a flow that both satisfies specific user interests and the democratic idea of news relevant to society. This questions needs further discussion and investigation, not only by the makers of algorithmic media but also researchers in the humanities and computer science, as well as journalists. In this regards, it is not so important to find a final answer but to establish different perspectives and theoretical concepts that help to grasp ongoing developments and help define a responsive system of governance. It is important, here, to distance oneself from technological myths and journalistic evaluations; like any technological system, algorithms are made by humans. It is hence important to obtain access and comprehension towards their makers in order to understand the purpose behind them and make statements about possible consequences.

What can be observed is that the development of personalized information flows challenges the epistemology of information in general and, more specifically, of news. Established definitions are contested by the developers of algorithmic media and their users. Bateson's (1972) oft-cited definition of information as "a difference which makes a difference" gains thereby new relevance. News is no longer primarily what is relevant in relation to journalistic news criteria from a societal perspective but also what users choose to make relevant. Information they click on, share and like gains visibility in new and often unpredictable ways. The makers of algorithmic media have identified this as a user need and market gap. Drawing on knowledge in the field of computer science, they created an application whereby news is understood as something that makes a difference to its users. Future researchers will therefore need to re-think the very notion of news related to contemporary digital applications. As done in this research, taking a starting point in the actual application instead of established theories may promise valuable insights and knowledge that is relevant in research and practice. Users further need to realize that they hold responsibility in the news ecosystem and researchers need to account for this in their research. Watzlawick's et al. (1967) famous axiom of communication led him to state that every behavior is communication. He claims that "one cannot not communicate" and hence relationships are defined by the behavior, respectively communication, of the partners involved. The same applies for algorithmic media: behavior is connected to communicative processes and they are of crucial importance.

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# Appendix

**Appendix A – Example of interview inquiry**

Dear Mr. Hasse, Mr. Hackamov and Mr. Rubinstain,

I am a PhD Fellow at the social science department at the University of Erfurt in Germany. In my research I am looking at automatic news aggregation and their impact on journalism. I am trying to understand algorithmic aggregation from a social science point of view.

On my iphone I have been using my6sense for quiet a while now and I am a big fan. I would be very grateful if I could do a case study about your company in my PhD. The case study would primarily include interviews with some or - if possible - all employees of my6sense. Questions would touch fields like history/development of algorithmic selection, impact on journalism in particular and society in general. It would also be great if it was possible to spend some time in your office in order to see how processes work and how decisions are made.

Of course all information I gather will be highly confidential and used anonymously in the written text. I am not trying to find out how your algorithms work. My research is more on a meta-level and looks at the relationship of automatic news aggregation and "traditional" journalism. Therefore it would be great to get some inside information from you as experts in this field.

For different reasons I will be in Tel Aviv some time in April (for sure during the week of April 16th to April 22nd but other dates would be possible as well) so if anyhow possible I would be very thankful if you could find the time to meet.

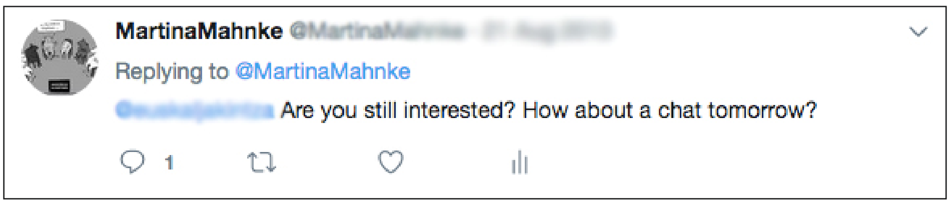
My research will include a comparison of three international case studies. I have already finished one with "commentarist" (www.commentarist.de) in Germany.

I am looking forward to hear from you. If you have any questions do not hesitate to ask! Thank you very much for your time and consideration.

Yours sincerely

Martina Mahnke

## Appendix B – Examples of an interview inquiry via Twitter

[redacted]
Replying to @MartinaMahnke
@MartinaMahnke you can contact me via cell [redacted]

[redacted]
Replying to @MartinaMahnke
@MartinaMahnke Martina, can you send me a working link?  Would be glad to if not too long.

---

**MartinaMahnke** @[redacted]
Replying to [redacted]
[redacted] I send you a mail - hope to hear back from you :)
1

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**MartinaMahnke** [redacted]
[redacted] I'm a German PhD student researching algorithms. Are you available for an interview about your work on algorithmic power? Thxs